

# Aviation Week & Space Technology

April 30, 1962

Thin Film Diode  
Breakthrough  
In Microcircuitry

7 Cents

A McGraw-Hill Publication

Vickers VC.10





The Visicorder Oscillograph records transducer response

A Type RN-100 "Rhot" temperature transducer, made by the RDP Corp. Hudson, N. H., is being tested here on a Visicorder Oscillograph.

The transducer is immersed in an ice bath and then in boiling water. If the tiny nickel grid is not adequately bonded to its rubber carrier matrix, the temperature response to the cold/heat bath is seriously changed. The Visicorder Oscillograph record shows that the RDP transducer under test had a proper grid-to-matrix bond because it met the specified time response to temperature change.

In corrosion applications, Visicorder Oscillographs can directly record up to 36 channels at frequencies from DC to 6000 cps.

For details, write *Monoscopes-Honeywell, Hybrid Division, 4000 E. Dry Creek Road, P.O. Box 5775, Denver 10, Colorado. Our DDD phone number is 303-794-4311.*



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**H** Fast in Control

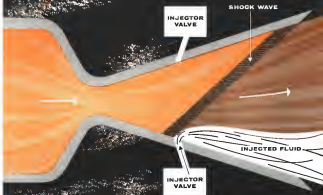
ROF CORPORATION  
HUDSON, N. H.

— TIME RESPONSE TEST —  
TYPE 3264 S/N 2  
TEMP. 32 ° TO 212 °  
6.5% RESPONSE 7 SEC.  
90% RESPONSE 15 SEC.  
ORDER NO. 130504 + M.H.  
DATE 6/24/61 TEST BY H.E.

## CAPABILITY is spelled

s-e-c-o-n-d-a-r-y i-n-j-e-c-t-i-o-n

The Aerospace Division of Vickers Incorporated has successfully completed a secondary injection thrust vector control system R&D program for the United States Navy.



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# How to keep a rocket ready



## Silicone rubber blanket keeps rocket fuel at constant temperature

Keeping the solid fuel of the NASA Scout launch vehicle at approximately 80 F required a heating blanket that meets two major design requirements. First, the blanket must be flexible for easy installation and handling. Equally as important, it must operate in any kind of weather.

These design features require the blanket manufacturer to choose materials with care. The matrix must be elastomeric and heat resistant. Since the heating energy is electrical, the blanket material must have electrical insulating qualities, too.

Silastic®, the Dow Corning silicone rubber was selected for its low coefficient of mechanical damage by temperatures from -130 to 500 F, moisture resistance and good electrical insulating properties all combined to make Silastic the ideal elastomer for this unusual application.

If you need gaskets, control cable, air seals or other ground support equipment parts made from rubber, consider the chart of Silastic properties below.

Effect of Heat Aging on Typical Silastic Stock

Temperature	Hours	Residual, %	
		Flex Life*	Tensile A
300 F	0	OK	56
	168	OK	59
	1344	OK	64
	6336	OK	65
350 F	0	OK	56
	168	OK	55
	1344	OK	62
	5650	OK	68
400 F	0	OK	56
	168	OK	60
	1344	OK	70

\*250% break of 1/4" sample over 1/2" diameter - no cracks

For more detailed information about Silastic heat resistant rubber and a list of part size gloss, write Department 1128, Dow Corning Corporation, Midland, Michigan



**Dow Corning**

## AEROSPACE CALENDAR

- May 7-Orb Air Parcel's 10th Anniversary Commemorative Banquet, Statler Hotel, Washington, D.C.
- May 7-Astronauts & Propulsion for Space Environment Symposium, Society of Aerospace Material and Process Engineers, Hotel Statler, St. Louis, Mo.
- May 9-10-Aerosol Conference, Society of Photographic Scientists and Engineers, Sheraton Hotel, Boston, Mass. Co-sponsored by AF Cambridge Research Laboratories.
- May 13-1962 Tool Exposition & Engineering Conference, Public Auditorium, Cleveland, Ohio.
- May 8-Management Conference on Man Itting in the Defense Industry, Boston College, Chestnut Hill, Mass. Sponsored American Marketing Ass'n., Society of Business Research, Spring College.
- May 8-10-1962 Annual Electronic Components Conference, Marriott Twin Bridge, Vienna, Va.
- May 10-1962 National Conference on Powerful Guns of Space, Seattle, Wash. Sponsored National Aeronautics and Space Administration.
- May 8-11-1962 Aerospace Meeting, Quorum Research Society of America, Sheraton Hotel, Washington, D.C.
- May 10-12-Western Regional Conference on Air Traffic Control, Ala. Sheraton Hotel, Sacramento, Calif. Fly to Dallas AFB.
- May 14-16-National Aerospace Electronics Conference, Langley AFB, Langley, Va. Sheraton Hotel, Dayton, Ohio.
- May 14-16-Joint Technical Society Dayton (Continued on page 7)

## AVIATION WEEK and Space Technology

April 30, 1962  
Vol. 24, No. 18

AVIATION WEEK and SPACE TECHNOLOGY is a unique publication that provides a comprehensive overview of the latest developments in aerospace technology. The magazine covers a wide range of topics, including aircraft design, space exploration, and defense technology. It is a must-read for anyone interested in the aerospace industry.

The magazine is published by the AVIATION WEEK and SPACE TECHNOLOGY COMPANY, which is a subsidiary of the AVIATION WEEK and SPACE TECHNOLOGY GROUP. The magazine is published monthly and is available in both print and digital formats.

The magazine is a valuable resource for anyone in the aerospace industry, providing up-to-date information on the latest developments in the field. It is a must-read for anyone interested in the aerospace industry.

Subscription rates: \$10.00 per year (12 issues). Single copies: \$1.00. Payment in advance. All orders subject to credit review. Write: AVIATION WEEK and SPACE TECHNOLOGY COMPANY, 1000 AVIATION AVENUE, AVONDALE, CALIF. 91804.

## SWEDEN AND NORWAY CHOOSE Selenia ATCR-2 AIR TRAFFIC CONTROL RADAR



After a detailed analysis of competitive radars by the technical and operational experts of Sweden and Norway, Selenia radars were chosen. Selenia ATCR-2 dual-channel air traffic control radars are to be installed at Stockholm (Bromma) and Oslo (Fornebu) airports. These radars are ideally suited for coping with today's traffic problems. Long-range area control involves detection of even small jet aircraft. Close-in approach and departure control involves high data-rate and extremely high target visibility within heavy cloud radar clutter. The Selenia radar solves both requirements. Can the ATCR-2 help with your air traffic control problems as it will in these countries?

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## AEROSPACE CALENDAR

(Continued from page 5)

- meet of Defense Symposium on Ther-  
mally Protected Components, Arden Hall  
Colorado Springs, Colo.
- May 14-17—1st Annual National Confer-  
ence, Society of Aeronautical Weigh En-  
gineers, Regency Park Hotel Seattle
- May 16-18—Spring Meeting, Society for  
Experimental Stress Analysis, Sheraton  
Orlando Hotel, Dallas, Tex.
- May 17—Rapidway Meeting, Jet Turbine  
Eng., Allison Division, General Motors  
Corp., Indianapolis, Ind.
- May 20-24—Annual Conference, American  
Assn. of Airport Executives, Ambassador  
Hotel, Los Angeles, Calif.
- May 20-26—Annual Meeting, Aviation/  
Space Weather Assn., Mark Hopkins Hotel,  
San Francisco, Calif.
- May 21-23—Annual Meeting and Aviation  
Test Safety Session, National Fire Pro-  
tection Assn., Sheraton Hotel, Philadelphia,  
Pa.
- May 21-25—Second Annual Air Transport  
Forum Conference, New York University,  
Washington Square Center, New York,  
N.Y. Co-sponsor: International Trans-  
port Institute.
- May 21-25—High-level Aerospace Techno-  
logy Symposium and National Techno-  
logy Conference, Sheraton Park Hotel,  
Washington D.C.
- May 22-24—Conference on Self-Organizing  
Systems, Museum of Science and Indus-  
try, Chicago, Ill. Sponsor: Office of  
Naval Research, Air Force Research Foun-  
dation.
- May 22-24—National Microwave Theory &  
Technology Symposium, Institute of Ra-  
dio Engineers, Boulder, Colo.
- May 24-26—Seventh Region Guidelines to  
Space Communications, Institute of Ra-  
dio Engineers, Seattle, Wash.
- May 27-29—International Space Systems  
Vision International Airport, Miami, Fla.
- May 28—Symposium on Recent Develop-  
ments in Astronautics Sciences, Institute  
of the Aerospace Sciences, Los Angeles.
- May 29-June 3-14th Annual Wright Me-  
morial Glider Meet, The International  
Glider Society of Dayton, Inc., For 14th  
Triennial, P. O. Box 981, Dayton 29, Ohio.  
Jen., 4-24-1967, National Council, Seattle  
(Hilton Hotel), New York, N.Y.
- June 4-7—New persons on Standards for Pil-  
lars of Wind Tunnel Research, Physics, Naval  
Ordnance Laboratory, Silver Spring, Md.
- June 6-11—19th Annual Radar Symposium  
(extended format), Institute of Inven-  
tion and Technology's Radar Laboratory, Uni-  
versity of Michigan, Ann Arbor.
- June 9-9-13th National Maintenance and  
Operations Meeting, Boeing Aviation  
School Inc., Reading, Pa.
- June 11-15—Sixth National Conference,  
National Aviation Electronics Council,  
Seattle, Wash.
- June 15-17—Annual Meeting, Heat Transfer  
and Fluid Mechanics Institute, University  
of Washington, Seattle, Wash.
- June 18-Aug. 16—Advanced Subject Matter  
Institute on Nuclear Reactor Propulsion,  
University of Florida, Gainesville, Fla.  
Sponsor: National Science Foundation  
(Continued on page 9)

## Involvement: LIFE



## CONTRIBUTION...

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something that outlasts it."* —W. James

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## AEROSPACE CALENDAR

(Continued from page 7)

- June 19-21-9th Meeting Academic Delegates and Manufacturers Assoc., Anaheim Hotel, Los Angeles
- June 19-22-Summer Meeting, Institute of the Aerospace Sciences, Ambassador Hotel, Los Angeles Calif.
- June 20-23-Vacant Convention, Asafar Grand, Transportation Assn., Radio Hotel, New York, N. Y.
- June 21-27-8th National Convention on Military Electronics, Institute of Radio Engineers, Abraham Hotel, Washington
- June 21-26-Symposium on Electromagnetic Theory & Antennas, Copeland Div. mark, American Technical Society of Doctors, International Scientific Radio Union.
- June 21-25-Aerotech Conference, American Society of Mechanical Engineers, University of Maryland, College Park Md.
- June 21-25-21st National Meeting, American Meteorological Society, University of North Carolina, Asheville
- June 27-28-Ninth Annual Symposium on Computers and Data Processing in the University of Denver's Denver Research Institute, Elkhorn Lodge, Estes Park
- June 27-29-Just Automatized Control Conference, Institute of Radio Engineers, New York University, New York, N. Y.
- June 25-29-Fourth National Symposium on Radio Frequency Interference, Institute of Radio Engineers, Times House, San Francisco, Calif.
- July 17-20-Electrical Engineers Meeting, American Rocket Society, Park Center and Hotel Elkhorn Hotel, Cleveland, Ohio
- Aug. 18-19-Forum of Manned Vehicles in Air and Space, Institute of the Aerospace Sciences, Drexel Hotel, Seattle, Wash.
- Aug. 18-19-Nuclear Engineering Conference, Monterey, Calif. (Joint Meeting Institute of the Aerospace Sciences, American Rocket Society, American Nuclear Society)
- Aug. 20-21-Western Electronic Show and Conference, Institute of Radio Engineers, Los Angeles, Calif.
- Aug. 20-22-ET-19th Session, International Civil Aviation Organization, to conduct Rome Job
- Aug. 27-29-Symposium on Ballistic Missiles and Space Technology, Studio 1800, Hotel Los Angeles, Calif. Sponsors U. S. Air Force, Aerospace Corp.
- Aug. 27-Sept. 1-4-Third International Congress International Council of the Astronautical Sciences, New Congress Hall, San Union, Sweden
- Sept. 1-4-1967 Flying Display and Exhibit from Bureau of British Aircraft Corporation, Farnborough, England
- Sept. 10-14-Aerotech General Meeting in International Air Transport Assn., Dallas
- Sept. 10-13-11th National Convention & Aerospace Fairness, Air Force Area, Las Vegas, Nev.
- Oct. 20-21-Symposium on Dynamics of Manned Lifting Platform, Lufthansa, Philadelphia, Pa. (Attendance limited, for in attendance, see below)
- Oct. 20-21-22nd Annual Meeting of the General Chairman, Keesler, Mississippi, General Electric Co. NBDV Valley Forge Space Technology Center, Box 5775, Philadelphia 1, Pa.

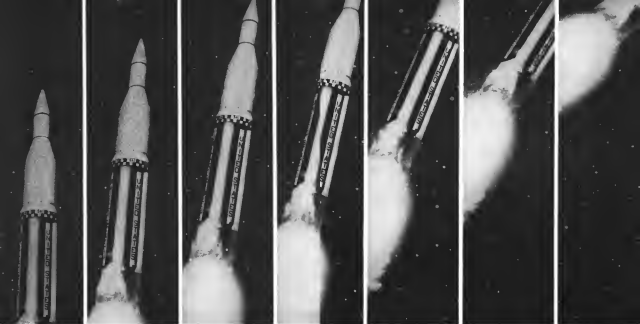


## Space age forge

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nington has continually exceeded project specifications. And production has been consistently ahead of schedule.

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**The Solution:** Translation of Man/Machine Technology into Integrated Control and Display Systems through Refined Management Techniques

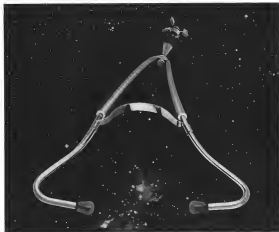
Acquisition of technical information required for the development of space systems must be rapid and efficient. By anticipating the problems of a system at development, the most effective way of acquiring the necessary technology can be determined and implemented quickly. Decoding the needs for data display is equal in importance to the development of the methods of display. The capability of Lear to translate system requirements into operable control and display hardware is widely recognized. Lear experience includes the development of wholly integrated systems for aerospace aircraft and space vehicles, and Lear possesses exceptional ability to acquire, process and display technical information for the ultimate in mission management. We call it Control Display Systems Management.



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for its use than the parts of a fine watch. The result: not only the greatest tracking accuracy ever achieved in an antenna of this type, but also the extreme sensitivity required for clear reception of faint signals from far distances in outer space.

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## Management in a New Environment

(Maj. Gen. C. H. Mitchell, vice commander of the Air Force Systems Command, recently outlined to the National Society Industrial Arm in Philadelphia some of the philosophies, activities and future plans of Air Force management. Because management is becoming a vital factor in today's rapidly-advancing technology, AVIATION WEEK is presenting excerpts from Gen. Mitchell's address.)

In today's new scientific environment, it is essential that our management practices keep pace with and be responsive to the rapid advance of technology. Just over a year ago the Air Force took a major step towards this objective. Following an extensive Air Force management study, the Secretary of Defense announced the formation of the Air Force Systems Command, effective the first of April of last year. At that time it was assigned responsibility for all phases of systems acquisition, thus placing both the area of research and development and the area of procurement and production under a single manager.

Within the Air Force, our systems management philosophy is expressed in a series of regulations which set up and define a concept known as the system package program.

System package programs are designed to ensure that system programs receive coordinated attention, cover and above the specified statements of any one functional or program but still make maximum use of functional capabilities. To achieve this end, offices known as system staff offices, or STSFO's, have been established at Air Force headquarters. These offices are responsible within the Air Staff for all matters pertaining to an assigned system. They provide a focal point for Headquarters USAF planning, programming, reporting, and related staff actions.

At the field division level there are offices known as system program offices or SPO's. The SPO's provide the operating management.

During recent months we have taken a number of specific actions to improve our management procedures.

At the top level in AFSC Headquarters we have a Management Improvement Board which is set up specifically to create a vigorous program of management improvement. It will provide overall guidance and direction for the continual effort in the management field.

Another source of improved methods and new policies, an assistant for management has been assigned to each deputy in our headquarters. These assistants for management are responsible for a continuous review of the work in their respective staff areas.

We are making increased use of management survey teams to conduct reviews of our programs and operations. These teams are made up of exceptionally well-qualified personnel—experienced individuals who are able to make objective evaluations and recommendations.

Management survey teams conduct several types of reviews of programs, facilities, and organizations. They can look at the managing and the functions of an organization, to see if the two match up. Or they can look at a program as a whole. One specific area usually included in the program survey is the area of system configuration control.

In the past we have had some difficulties in this area, but these difficulties should be largely eliminated in new programs like the Masterplan (CIMA) program. Now we are controlling in one command and one office the configuration of such major and its major support equipment until it is delivered in combat capable at its lastest using site.

The contractor reaction to the recommendations of our survey teams has been very encouraging. In one typical instance, a contractor accepted and acted upon 21 recommendations within a 30-day period.

In another area of management, we have achieved a close working relationship with the Air Force Logistics Command. AFSC and AFLC have established a number of joint experiments and experiments, and there is in general an excellent interface between the two commands.

As you know, we are sitting down with industry on specific programs in much the same way. For most of the major systems we have an executive management council composed of the presidents of the participating companies and the commanders of the Air Force activities involved. Because of the ever-increasing size and complexity of the management task, we have felt the need for a continuing source of professional management counsel from outside the Air Force.

To meet this need, we proposed—and Headquarters USAF approved—the establishment of a Board of Veterans for AFSC. The board, which is made up of a number of well-known scientific, educational, and industrial leaders, will serve as a source of advice on broad policy matters.

One of the first matters to be considered by the board is the continuing need to keep industry and the scientific community informed about management developments within the command.

There is a further aspect of management that deserves mention. During the past year we have placed increasing emphasis on the need to reward extraordinary performance by industry with greater profits and with corresponding reductions in profits for lower performance (see page 26). This is part of a concerted DOD effort to make maximum use of the profit method to obtain the objectives of quality, economy, reliability, and maintainability.

In line with this policy, the Department of Defense, a letter has been sent to all Air Force procurement activities stressing the use of contracts based on incentives in lieu of straight fixed price contract as offering the best incentive—both in the interest of the Air Force as well as industry. Each division of AFSC is now employing and studying greater use of performance, delivery, reliability and cost incentives.

This means that we have to define our job better before we write contracts in order that those incentives will be both meaningful and measurable and that we can go from cost-plus-fixed fee contract to incentive-type contract now.

It is increasingly clear today that military management does not exist in a vacuum. In the task of system acquisition, responsibility rests with the armed services, but both industry and the scientific community play a major role.

The success of tomorrow's aerospace strength must be a joint effort . . .



## We put 140 gallons in a 14-gallon bag!

This collapsible fuel tank is made of a remarkable new B.F. Goodrich material called Estane®. That's why, although the tank has a design capacity of 14 gallons, it took more than ten times that much fluid before it burst. Even then the electronically-welded seams remained intact.

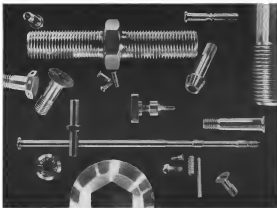
BFG "Estane" can be custom designed to fit complex configurations, to serve as fuel cells in sophisticated vehicles, tanks, ground vehicles, light aircraft. Made of Estane, they can be economically fabricated, yet have very high tensile strength at high ultimate elongations. Estane has excellent resistance to oils, fuels, various chemicals, and water. It withstands continuous operating temperatures as high as 260°F; retains flexibility as low as -60°F.

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aerospace and  
defense products

BFG also offers a line of standard collapsible one-tonne fuel tank storage, called "Storables". These portable fuel storage of many hydrous liquids and some corrosive liquids and slurries at low cost than rigid tanks or rigid equipment. For complete information on Estanes and Storables write B.F. Goodrich Aerospace and Defense Products, a division of The B.F. Goodrich Company, Department AIR 4R, Akron, Ohio.

3000 gallon  
"Storable"  
for bulk  
storage of fuels





## From SPS... Titanium fasteners in any configuration!

### Totally integrated titanium facility permits 2 weeks' delivery

First to successfully produce threaded fasteners of titanium, SPS offers components of this extraordinary metal in any size or shape that your aircraft and missile designs may desire. And because SPS operates a totally integrated titanium plant—sales effort, tool laboratory, manufacturing facilities, inspection and shipping departments—you get the fastest possible delivery... if necessary, within two weeks of your order.

It is not surprising that aircraft designers have specified SPS Ti-Ti over any fastener for heavily loaded applications. Here are major advantages:

- Light weight—only 55% that of steel. We get saved in aircraft or missile design greater fuel economy, increased range, better payloads, lower costs.
- High modulus—the fatigue strength-to-weight ratio for steel is 70-100 psi/lb per sq in.; for titanium, 375,000 psi/lb per sq in.
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- Nonmagnetic—particularly important in aircraft electronic equipment.

- Low thermal expansion—smaller clearances required for expansion joints, increased efficiency in applications like jet engine compressor wheels and blades.
- Lighter and stronger than stainless steel.

To verify the reliability of its Ti-Ti Titanium strength bolts and special parts, SPS maintains a testing laboratory in the titanium plant where tests of strength properties are run to meet Government specifications and to insure production. Resident Government inspectors are always available.

**Non-lease prices**—Primarily as a result of improved titanium fabricating techniques, we have been able to substantially reduce the prices on our Ti-Ti fasteners. View most items in the line as now at least at 42% under the price of three years ago.

For further information, write **SPS Titanium Products Corp.**—manufacturer of precision threaded fasteners and allied products in many metals, including titanium. Regent Building, 2239 Alameda Avenue, Denver, CO, 80202, or SPS, Inc., P.O. Box 100, Santa Ana, California.

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## WHO'S WHERE

### In the Front Office

**Elmer T. Whetson**, rising vice president and general manager of a new Space Programs Division of Lockheed Missiles and Space Co., Sunnyvale, Calif. Other Lockheed Missiles and Space Co. appointments: **D. J. Mayhew**, general manager, Development Division; formerly, the General Services Division; **R. F. Berchmans**, director of a new Company Planning Staff; A. Product Activities Division. His new assignment is to establish project elements and the following has been named the director: **R. G. Gibson** in Space Systems Division.

**Thaddeus W. Johnson**, Los Angeles leader, named a director of Douglas Aircraft Co., Inc., Santa Monica, Calif.  
**Dr. Theodore Beucha**, chief of the West German Federal Agency for Defense Technology and Procurement with head quarters in Bonn, Germany. Dr. Beucha arrived in chief of West German as their research and development.

**Richard K. Mosher**, president of LFE Electronics, major operating group of Electronics for Systems, Inc., Santa Ana, Calif. **Richard C. Sweeney**, president, Thorside, a division of Electronics for Systems.

**Dr. Patrick Behrens**, head chairman, Westinghouse Electric Corp., West Nyack, N.Y.  
**J. K. E. O'Brien**, vice president of Helicopter Division, Lockheed Missiles and Space Systems Division, Douglas Aircraft Co., Inc., Santa Monica, Calif.

**John R. O'Brien**, a vice president of Helicopter Division, Lockheed Missiles and Space Systems Division, Douglas Aircraft Co., Inc., Santa Monica, Calif. **Dr. James W. Jones**, vice president of O'Brien in Washington manager for Helicopter Division, Lockheed Missiles and Space Systems Division, Douglas Aircraft Co., Inc., Santa Monica, Calif. **Dr. James W. Jones**, vice president of O'Brien in Washington manager for Helicopter Division, Lockheed Missiles and Space Systems Division, Douglas Aircraft Co., Inc., Santa Monica, Calif.

**John E. Kist**, III, vice president engineering and a director, Lockheed Electronics Corp., Portland, Me.

**John H. Carter**, current vice president of Westinghouse Electric Corp., Boston.

### Honors and Elections

**James V. Reynolds**, director of Helicopter Division, Douglas Aircraft Co., Inc., Santa Monica, Calif. **Dr. James W. Jones**, vice president of O'Brien in Washington manager for Helicopter Division, Lockheed Missiles and Space Systems Division, Douglas Aircraft Co., Inc., Santa Monica, Calif. **Dr. James W. Jones**, vice president of O'Brien in Washington manager for Helicopter Division, Lockheed Missiles and Space Systems Division, Douglas Aircraft Co., Inc., Santa Monica, Calif.

**Walter L. Anderson**, vice president of General Electric Co., has been elected chairman of the Institute of Radio Engineers, Professional Group on Electronic Computing.

**E. J. Doyle**, vice president-engineering and product development for Douglas Aircraft Co., has been elected chairman of the Aircraft Technical Committee of the Aerospace Industries Assn. (Continued on page 35)

## INDUSTRY OBSERVER

Planned as entry of USAF/Douglas Selschil air-launched ballistic missile will not be completed in Boeing B-52H aircraft before mid-1967 at present rate of development, testing and program production. Approximate 1,500 of the missiles will have been produced by that date.

First titanium to be fabricated by this film deposition as a non-solvent-free, non-aqueous-coated base, representing a major development in thin-film semiconductor technology, have been made by Sybron's Microelectronics Laboratory. These materials follow closely Sybron's recent success in depositing titanium dioxide on specially treated ceramic wafers (see p. 20).

**R. C. Selschil**, formerly vice president for engineering, General Dynamics/Convair, will become a consultant to Robert K. Gilchrist, Director of NASA's Manned Systems Center, Houston, Texas. Selschil will advise on engineering and manufacturing aspects of the Apollo development program.

Contracting of funds for Air Force/Boeing Dyna-Soar boost-glide vehicle may not permit inclusion of sensitive systems, such as radar and infrared, in first vehicle for orbital flight scheduled for November, 1964. Fiscal 1963 may see as much as \$20 million financed from program's subsequent effort. Boeing is checking for supplier equipment which might be used in the program.

French second stage for ELDO, the European Launcher Development Organization (AW No. 23, p. 28) will retain its elements of a prototype solid-propellant main stage designated Diamant (Diamant) now under development by the French consortium SEAE.

Proposals for low-observability reentry vehicle, incorporating undetectable electromagnetic characteristics, are due the latter part of May at Air Force Systems Division. Program is expected to proceed at hardware development. Bidders include Altimore Instruments Lab., Avon, Cleveland, Emerson Electric, Ford's Aerometrics Division, General Electric, General Mills, Lockheed Missile and Space Co., Martin, North American Aviation and Radio Corp. of America.

Competition for integration, assembly and checkout of Air Force's Ballistic System Division vehicle involves major ballistic missile program has a May 21 deadline for submission of proposals. Requests for proposals have been sent to 20 industry members.

Douglas Aircraft has completed design studies of the Robonaut spacecraft and the means for jettisoning three inflatable spheres into orbital environment as part of a passive communications satellite system. After NASA evaluates the study in two or three weeks, proposal targets for hardware probably will go to industry.

Aerospace Force funded study at General Dynamics/Aerometrics in proceeding under an additional \$1.5 million from USAF.

Air Force Space Systems Division is considering a program for a manned booster vehicle system. Dyna-Soar boost-glide orbital vehicle fitted with basic and advanced radar systems for USAF's advanced radar system. Satellite and/or vehicle will be proposed by Boeing for the manned space-vehicle and inspection role.

New, in working version for its month study, of preliminary problems involved in Project Iridium, flying of satellites from Boeing, contractor in the new April 16 closing date for interested firms to notify Navy Personnel Office in San Diego.

First flight in McDonnell's Project Ascent to test hypersonic, lifting re-entry vehicle (AW No. 5, p. 50) may be delayed until early 1965 because of program changes and unavailability of Soviet hardware.



Bar rolled on Haynes Stellite's 24-6 alloy will also be participants at jet engine temperature.

## A good answer to a hot problem

Where can you find a material that is strong at high temperatures (in the range of 1000 to 2000 deg. F), and maintains resistance to oxidation, creep, and thermal shock, too? Your answer may be any one of 17 HAYNES high-temperature alloys. These alloys are giving excellent service in the hot spots of jet engines, missiles, rockets and in many industrial heat-treating applications.

Haynes Stellite can supply you with high-temperature alloys in cast or wrought form. Or, with parts—any size, shape, or quantity, completely fabricated and finished to your specifications. That's the big difference when you deal with Haynes Stellite.

Would you like more information or help in the solution of a tough high temperature problem? Write to Haynes Stellite Company, 230 Park Avenue, New York 17, New York.

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## Washington Roundup

### Anti-Secrecy Moves

National Aeronautics and Space Council, whose leaders were instrumental in getting the Pentagon to declassify the goddard satellite project (see p. 34), is likely to join the effort to loosen the secrecy lid recently clamped on military space activities (AW Apr 16, p. 15).

So far the House Government Information Subcommittee has been the only official and openly questioning the wisdom of the Pentagon's secrecy decision. Just, however, subcommittee chief investigator, went to Cape Canaveral last week to find out how serious government public information officers and scientists there felt about the secrecy order. Subcommittee studies this week plan to discuss the decision with Arthur Schweitzer, assistant secretary of defense for public affairs and other Pentagon officials.

Secrecy order was written by Under Secretary of the Air Force Joseph Clark and signed by Deputy Secretary of Defense Russell Colwell after consultation with Secretary of Defense Robert McNamara. The director, said a source. "The order aimed to implement the doctrine said: 'They will have to add another floor to the Pentagon to administer this one.'"

Space council concern about secrecy extends to Vice President Lyndon Johnson, its chairman, who participated actively in the effort to declassify the ANNA goddard satellite. Dr. Edward Weiler, executive director of the committee, who also is, and the declassification kept a constant check on the Defense Department series of the ANNA project. He already is convinced the "need-to-know" philosophy in the Pentagon's doctrine should be broadened and he is likely to play a quiet but active role in getting the decision reversed.

### Senate Missile Study

Congress is preparing investigation into missile hardware and their command systems. The Senate Armed Services Investigative Subcommittee will hold hearings, probably late this month, to inquire about missile reliability, with viewing systems and missile command and control systems. Initial estimates will be from the Defense Department, but industry missile specialists may be called later. A House space subcommittee is considering hearings to explore the causes for delays in the Gemini program (see p. 35).

Missile Lt. Col. John Glenn, Jr., at the Third Annual International Space Conference in Washington this week is expected to meet one of his staff-building counterparts from Russia-Maj. Gheorgiu Todor second Soviet cosmonaut to visit the earth. Both men are slated to participate in the conference sponsored by the Committee on Space Research.

### Non-Profit Investigation

House Armed Services Investigative Subcommittee is shifting the form of its probe of non-profit expenditures to such so-called "black business" as the Road and Auto corporations.

Review is that the Budget Bureau study of non-profit-almost sent to President Kennedy—discovers that the use of such services expended by the Aerospace Corp. last touches only lights on the property of past research contracts.

In the upcoming hearings, expected to start late in May, Subcommittee Chairman Edwardrlen will concentrate on trying to determine whether the armed services and Defense Department are neglecting their cost-accounting responsibilities in allowing too heavily on their contracts with non-profit firms.

### Supplemental Airlines

Financial future of supplemental airlines is being discussed both by Military Air Transport Service contract airlines and by the persistent refusal of House conferees to grant the lines anything but temporary, individual-brokered authority in pending legislation.

MATS, instead of awarding Fiscal 1965 larger contracts to the lowest airline bidder, is quietly negotiating most of them. The largest contracts will total about \$75 million in Fiscal 1965, compared with \$51 million in Fiscal 1962.

Chairman Mike Mansfield of the Senate Aviation Subcommittee will try to knock the ongoing ongoing Senate-House conferees on the whole different bills in proposing that a final portion of the supplemental airlines' business be indefinitely delayed. He has tried to get House agreement on 10%, but could not even get agreement for 20%. So the compromise to be proposed in the next few days probably will entail a figure under 20%.

Space Age note: Only held on the Saturn C-4 launch last week lasted 30 min. and was ended by a timer which ignored as normal all the warning signals and allowed death under the light path.

—Washington Staff





Skybolt falls from B-52G launcher during first live drop firing. Two-stage solid rocket is 59 ft long.

## Skybolt Successfully Air-Launched From B-52G



Left: In, below, scenes after Skybolt is clear of aircraft. Tail cone is blown free from missile, which is in a tight cone down attitude.



Skybolt pulls away from launch carrier, latter rising up into ballistic trajectory. Second stage did not ignite.

First drop launching of the Air Force Skybolt air-to-ground ballistic missile was made by a Boeing B-52G bomber offshore from Cape Canaveral down the Atlantic Missile Range Apr. 15. Solid propellant motor is made by Aerojet-General, the guidance by Northrop and the aircraft compatible by Boeing. Target data for operational Skybolt missiles is 1964. Four will be carried by B-52G and B-52H aircraft and two by the British Avro Vulcan bomber. After release, the Skybolt falls from two to six seconds to free position 200 to 1,000 ft below the aircraft. Skybolt will enable the launching aircraft to stand off up to 1,000 mi. and hit moving targets. The first live firing tested flight control, propulsion, staging and some elements of guidance. A pre-launch computer also made by Northrop, has been designed to accommodate two of the missiles. The B-52s, therefore, will carry two (one primary and the Vulcan one). Currently, 25 development missiles are programmed for launchings at about one per month. Launch B-52s take off from Eglin AFB on the Gulf coast of Florida and proceed to the Atlantic Missile Range.



# NASA to Analyze Requirements For Manned Round Trip to Planets

By Irving Stone

Los Angeles—Requirements for the first manned round-trip mission to Mars and Venus, projected for the 1970-1975 time span, will be analyzed by a new NASA, 4,000-man-hour study ready for National Aeronautics and Space Administration's Marshall Space Flight Center.

Proposals as the competition for the study were submitted under Proposal Award Request No. TP-74-061 at the end of March by eight aerospace industry members. Contract award will be made for the end of this month.

The mission for manned reconnaissance for the nearest planets is seen as a step beyond Apollo, and involving definition of new advanced techniques and vehicles such as new operational concepts, the Saturn C-7 as a low-orbit launch path and a low ballistic angle in contrast to the steep launch angle and associated high altitude required for a direct departure path.

• **Vehicle studies** should be relatively short. Approximately one year in the shortest duration which reasonably can be expected.

• **Overall mission profile** should be simple. The over-extended type of mission appears to meet that approach.

• **Crew commander** with Minn and/or Venus should occur.

• **Mission** should serve as a development and training exercise for follow-on goal of manned planetary landing.

• **Requirements generally** should not exceed substantially the state-of-the-art development for the Apollo mission and, if possible, no fundamentally new requirements should be involved beyond those necessary for the Apollo follow-on.

These five awards apparently can be met using a Concord and together for the mission public, utilizing an earth-to-

orbit transport vehicle no larger than Nova, injecting from earth orbit with a nuclear high-thrust propulsion system and, possibly using upon return, a direct entry technique into earth's atmosphere. Concord profile, developed in 1956 by Italian scientist Gen G. Grassi, would allow passing in vicinity of Mars and Venus in one round trip. The spacecraft would depart from earth, pass to the rear of Mars, use that planet's gravitational field to adjust the spacecraft's path toward Venus, then use the gravitational field of Venus to redirect trajectory to earth.

Initial earth-orbit could provide a comfortable launch window for the round trip, as permit rendezvous with another element of the spacecraft or other spacecraft if a mission or arrival period is needed. Also, the pathings to Mars and Venus could be a low-thrust launch path and a low ballistic angle in contrast to the steep launch angle and associated high altitude required for a direct departure path.

• **Concord** study award should be awarded to determine if a better approach is available, and how to proceed from this first mission to follow-on constant loading to manned planetary landing.

• **Nuclear propulsion system** will be studied to determine what additional demands will be made on the Nova engine if this threshold powerplant is utilized. Second-generation nuclear propulsion system should be considered to determine applicability for the mission, but the study contractor will be required to weigh these developments against projected mission time period.

• **Chemical propulsion system** also will be considered to determine if applicable system already exist or can be obtained by modification of existing system, as whether new systems are required. Development of large chemical engine system is to be avoided.

• **Procedures for orbital operations**, in flight rendezvous, and mission timing will be investigated.

• **Subsystems** will be evaluated to determine which subsystems, such as communications, power, supplies, guidance and control, life support, engine storage, rescue, radiation shelter will have to be developed.

• **Earth-to-orbit** mission will be studied for direct atmospheric entry, conclusions of rocket braking and direct atmospheric entry, and establishment of an earth orbit and then return to earth's surface. For its operational aspect involving rocket braking, consideration will be given to the availability of an-

start of the nuclear launch engine or to include an additional engine or thermal system for the task.

• **Estimates** will be made for the number of astronauts required to crew the interplanetary vehicle, the number of vehicles to start the mission, and how the vehicles would assist each other.

• **Development plan** will be outlined, including requirements for special ground facilities, manned land, if required, mission, test and development flights, crew training and data collection.

• **Funding plan** will be developed for hardware and operations, discussing nuclear advantage of developments which are part of the overall system program. Research and development costs for Nova or Nova vehicles, Apollo capsule, and Nova engine, etc., will not be included, but appropriate modification and procurement costs will be determined.

• **"Come-look" trajectory** will be required as a minimum requirement for test flights, and an exact trajectory is included for the mission flight, including required launch time variables, mission time, rendezvous association, and related data.

• **Scientific aspects** of the mission, including scientific payload requirements, will be investigated in detail.

• **Life support systems**, vehicle configuration, environmental protection system, and crewmember handling system will be delineated.

• **Guidance and control**, internal power supply, and associated electronic systems will be outlined.

• **Checklist of the most probable emergency situations** will be outlined, together with details on how to cope with these contingencies.

## Gemini Rockets

Small maneuvering rockets for Gemini two-person spacecraft to use in orbital rendezvous flights are to be developed by North American Aviation, Rockwell Division under contract to McDonnell Astronaut Corp.

Small solid-fuel grain propulsion rockets will be used in rendezvous and in various combinations to control attitude and speed for the National Aeronautics and Space Administration spacecraft in small orbit only. It is scheduled for fly tests in 1965 or early in 1966.

Engine nozzles and shrouds are to be cooled by ablative and propellant will probably be in the oxidizer intermediate distance family of combinations, though no fuel structure has been worked out.

The eight rockets are to be used in a total launch unit to control the energy movement they supply. Rockwell has developed but using solid propellant of shaping and shaping the engine up to 200 times per second.

# DOD Stressing Cost Overrun Reductions

By Russell Hirsch

Los Angeles—Defense Department plans two additional, significant changes in military procurement cost control and budgeting. Charles F. Hirsch, assistant secretary of defense, told an aerospace industry group here. These will be:

• **Change** which would increase program costs by more than \$10 billion a year in the \$25 billion for duration of the program will be made only by the Secretary of Defense.

• **Defense Department** will begin full funding of procurement programs in fiscal 1964, with the exception of some Air Force missile programs. Full funding in the concept of requesting Congress to authorize in one law all the money needed for a program.

Hirsch says an objective of DOD's increasing attempts to reduce cost overrun and to obtain a more realistic picture of total program costs.

Hirsch said that program participants are placed in for a year in cost and that the management tool before putting it into operation, but he said more progress has been made than would otherwise have been possible.

In the first year, many requirements studies were completed, one tentative five-year program was developed which provided guidance in making the budget request, a complete five-year program requirement was issued, more information was brought to bear on the defense program problem areas and Congress was given its first long-range look at the military budget in its consideration of the 1965 budget request.

Hirsch said he is opposed to any change less the existing functional division of defense appropriations to a project division which some have recommended. He said such a move could be an industrial gas in efficiency and would be likely to produce no loss. The broad functional grouping of major items is flexible and permits cost adaptation to the needs of the military but it has not been a success. The recognition of research development, test and evaluation as a separate appropriation has proven successful and flexible.

However, the Administration has concluded that this basic budget process and its functional management system were deficient in a number of respects for the total decision-making task. One deficiency was the lack of inter-service coordination and agreement on structure which is required to be solved by the various service departments in the effort.

Another deficiency was the gap between long-range planning and budgeting in the defense appropriation

and military departments—especially in the needs of those who must enter the budget decisions on the broad aspects of the defense program. This trend toward inter-service agreement will continue in the future. The dependence of the Army on tactical air support by the Air Force is but one of the more obvious examples of the need for an overall Department of Defense approach to the allocation of resources in defense planning.

"Specially, the clearly apparent necessity to have balanced forces made and equipped to fight the same kinds of war arrived at from across militarily and administratively concept of commonality should make it plain that a common plan in cost, independent of the other risks the risk of serious error."

Noting that the 1965 Defense budget was the first prepared under a new three-phase program—planning, programming and budgeting—Hirsch claimed more than satisfactory progress in the view since Defense Secretary McNamara ordered its adoption. Hirsch said that he has been in the position of making the management tool before putting it into operation, but he said more progress has been made than would otherwise have been possible.

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Nike Zeus Tested

Double test hardware program at AECU/Weapons Effects Nike Zeus AECU test site is visible in the new area that are the front of the coastal coastal missile. During the partially successful 11th launch over the Pacific Missile Range from Ft. Meigs, Calif. Apr. 18, December step test but boundary loss to prevent it from being the second attempt of the missile. Appear border dislocation is implied due to notes being. Double test three right side of the lower one cover from we cannot prove that test procedure is guaranteed in the new. Missile was destroyed after apparently destroyed from planned mission in later stages of the test.

## 156-in. Solid Proposals

Reports for proposals for development of a 156-in. solid propellant motor are to be released this week at the contract for the 120-in. motor is awarded. Defense Department wants to award the 120-in. contract before proposals are out on the larger motor.

The 156-in. motor program will be managed by USARF Systems Command's Space Systems Division. R&D and off task from National Aeronautics and Space Administration recently completed the final work statement for the project.





## DOD Secrecy Ruling Confuses Industry

Washington-Defense Department last week bowed to pressures generated by scientists and professional organizations when it ordered declassification of the ANNA guided missile project. The decision added to the confusion generated by a general directive, which originated at the highest level of government, placing a severe clamp on as much as defense military space projects. The directive stated that "all information about ANNA (Air Force, Navy, NASA and Army) could be declassified, except for some of the reduced data obtained. Details of the Titan Atlas booster and the vehicle itself will be made available by the Navy's Bureau of Weapons, which has primary responsibility for the project."

The space society directive, issued over the signature of Deputy Secretary of Defense Russell Galtman May 23, has caused confusion and delay among military intelligence personnel, aerospace society program directors and at state administrations (AW Apr 25, p. 21).

## Republic Demonstrates Reconnaissance Drone

New York-Small reconnaissance drone aircraft, developed by Republic Aviation Corp.'s Missile Systems Division for the Office of Naval Research, was demonstrated at the Marine Corps Center this month as a potential aid to special forces in minimum number of ground personnel.

Plane is powered by a small turbine-burner gas-turbine engine, and is not much larger than control box model airplane. Wingspan is on the order of four or five feet, the fuselage is laminated, wingtip, nose control system and engine compartment, can be carried in backpack by two men. It takes a few minutes for the men to assemble and fuel the drone, load the camera,

## British Aircraft Operational Requirements

London-Top-level public-military committee is currently meeting here to determine the future of three British aircraft operational requirements, with final report to be submitted scheduled for early June.

Requirements at stake are:

• **OR131**, a twisted V-shaped fighter for the Royal Air Force. Completion on the Armstrong Whitworth 651, Bristol 206 and the Short Belfast (AW May 5, p. 20). All are now completed versions, with the initial two designed around low-speed Subsonic, B-555 retained three engines. Initial includes Rolls-Royce lift engines for takeoff.

• **OR135**, a constant reconnaissance airplane to replace the present Shackleton. Air Force is bringing the Shackleton to MA 1 conversions, including a turbojet landing gear, and meanwhile is working on company-based feasibility study to design a replacement, either subsonic or supersonic. Air Force has just designed an advanced theory airplane, in which one engine would be shut down during the project was developed. In addition, VAW-12/2000 is expected to be working out military use of an FV 104 low cost transport. By this date, more British philosophy states on more than two engines when operating at speeds up to 1,600 mph. In fact, for this reason the Republic Aircraft is not considered a low cost transport. Requirement will call for variable geometry wing.

• **OR141**, a small area fighter involving use of variable geometry. Both Bristol Siddeley advanced project team and British Aircraft Corp. are working on this requirement.

click on the operation and launch the airplane.

Joint government unit—which can deliver limited positive or negative force from distant cameras (the only extra fuel and space ports make up a load for another part of man). The drone is to launch day or night photographs show jet, radar, gas expenditures and weather data. Primary object of the development was to meet a military need for a simple, lightweight reconnaissance vehicle that can operate over short distances, return results in minimum time and be operated by minimum number of ground personnel.

Other use proposed for the drone include possible evaluation of a tele vision camera and transmitter instead of the aerial TV camera, in transport and air drop of missile and other weapons.

Marine Corps and Army personnel watched the demonstration at the Queen's Marine Corps Air Station.

## Ruling Will Expedite Minuteman Site Work

Washington-Basing Co. expects an acceleration of Minuteman base, now getting under way, to be greatly facilitated by the possibility of work stoppages contained by a Labor Department opinion which will permit the company to use its own specialized factory-owned areas instead of local construction labor.

The opinion, issued by Charles Donahue, Labor Department solicitor, specifically relates to the Basing company's plan for activation of the Minuteman AFB site at Great Falls, Minn. It exempts all work under the Basing contract—covering the main construction—of the Basing-Basing Act. Work covered by the Basing-Basing Act, requiring the government to pay the prevailing wages for construction work, would give production to the building trades union.

The gap area between the first phase of work—base activation, including both main and auxiliary within the perimeter of the construction site, and the second phase—rebuilding industrial union workers, has been a major cause of jurisdictional disputes leading to strikes by construction workers.

They claimed industrial employers doing construction work involved in the same jurisdiction were invading their territory.

Basing Co.'s workers are organized by the International Union of Machinists.

The company plans to move its base of operations from job to job as work progresses.

## Emphasis Shifts to Venus Probe After Disappointing Ranger Flight

U.S. lunar planetary program will shift to Venus following the fourth Ranger flight last week which failed to achieve its primary objective. While the primary objective was to obtain close-up photographs of the moon and data on the composition of its surface. Two Marsner B probes will be launched in the July-September period in attempts to fly by Venus. The Ranger 4 mission, from the Atlantic Missile Range at 3:30 p.m. (EST) Apr. 23. Major significance of the flight was the near perfect performance of the Atlas Agena B launch vehicle configuration from the first time the vehicle has been fully satisfactory. In four National Aeronautics and Space Administration missions.

Ranger 4 entered the edge of the sun's disk at 7:40:55 a.m. Apr. 26 after a 251-hour flight. The spent Agena B stage went into a solar orbit, with elements not completed last week. Impact point was 229.3 deg east longitude, 131 deg north latitude, at a velocity of 10,000 mph.

For propulsion laboratory scientists who manage the payload portion of the Ranger series are that some data can be obtained about a presumed low-energy configuration surrounding the moon which it takes one another. But also is the only scientific information expected from the complex payload.

Although Ranger 4 was the first U.S. payload to impact the moon in an attempt, the success of the payload to perform its scientific mission was a better disappointment. For planning data indicates the payload orbital computer and computer failed when the payload was near the moon. The mission, the first Agena stage was in a parking orbit. The Twin Falls Station (including data was the last station to report good signals and the failure was reported by the radio station near Johannesburg, South Africa.

Physics testing was conducted for the first time in flight by use of a precision Doppler system, which revealed both main and auxiliary stage. Spacecraft batteries were dead after seven hours because the solar cell arrays apparently failed to deploy, and tracking from that point provided only irregular data. The probe was tracked by signals from the 90 m transmitter, operating on a frequency of 968 m, on the lunar landing signals.

At the time contact was lost, Ranger 4 was 106 m, above the lunar surface. It then lost contact, and the probe landed and impacted near the edge.

Impact itself without atmospheric and terminal correction was considered a

tribute to the Lockheed Agena B performance. D. L. Forrester, NASA Agena program chief, told Armstrong that the primary performance was near perfect, with a considerable error well within the ability of the course correction rockets—within limits of a second in time.

Ranger 3, launched Jan. 28, failed to achieve its objective when the Atlas booster burned 1.5 sec too long because the guidance system failed to provide the subsonic signal (AW Feb. 5, p. 18). Instead of impacting the moon, it impacted the earth. It was maneuvering with a Southwestern in Atlantic orbit.

Atlas Agena B will be the backbone of heavy duty NASA missions until Century becomes available, and James T. Watson, NASA administrator, said that the Ranger 4 flight shows the first time with the first time for 30 Agena B stages.

The Marsner B Agena B vehicle will be needed to launch the Atlas Agena B, which will be the backbone of a business area, could command capability. The Ranger 3 vehicle had a satisfactory command capability, which was not used.

## News Digest

Mr. Gen. D. J. Rifford has been named deputy commander of the Air Force Systems Command for Manned Space Systems with broad responsibility for planning and managing U.S. manned space flight effort, and for coordinating all NASA manned space flight activities with NASA as conducted by Armstrong Wurts (AW Jan. 23, p. 21). Forrester, Special Assistant Director, will have an office of about 35 staff members at Andrews AFB. This is a significant loss, since which has long been sought by both NASA and AFSC.

United Technology Corp. successfully demonstrated an extended duration firing of a 15 ton single solid propellant segment in a test lasting 130 sec, the longest firing time achieved by a solid propellant booster.

Dr. Hugh L. Davies, deputy assistant director of the National Aeronautics and Space Administration, was presented the Southwestern Research Society's Langley Gold Medal for "wise and responsible administration" at a dinner of the U.S. technical programs that make possible the conquest of air and space.

## UK-1 Launch Succeeds

U.S. successfully added to other space programs a variety of atmospheric measurement instruments developed by British universities. The satellite, designated UK-1, was launched at 1 p.m. Apr. 26 by a Delta vehicle, the eighth mission successful launch by the Douglas-developed probe from the Atlantic Missile Range.

At Florida Missile Range, Air Force launched two satellites Apr. 25, one called by a Star Scout and the other is, so Miss Agnes B. Details of the payloads were not revealed (see p. 24). But Air Force System Command had asked only a preliminary attempt in its first satellite program. First attempt was to be made under the name of a reconnaissance with a Southwestern in Atlantic orbit.

The 131 lb. UK-1 satellite was scheduled to be launched on a 200-600 m orbit, and will take battery after the first orbit. Details of the payload and the job were in planned.

Aermet-Gorham will be under \$4 million Air Force follow-on contract next week. Last week had paid last week under contract of two \$100,000 contracts, for Aermet-Gorham, and two \$40,000 contracts. One of the new Aermet-Gorham contracts was scheduled for last week. Aermet-Gorham has been the 100 m data station under present contract to Air Force.

Crash of Breguet 1150-02 Atlantic ASW prototype aircraft during a test flight Apr. 19 is not expected to delay development of the Breguet 1150-02. First prototype Breguet 1150 is flying and third is due to fly out soon. An explosion tore the left wing off the loaded aircraft.

Dr. Frederick Seitz has been elected president of the National Academies of Sciences, succeeding Dr. Delos W. Black who has served three terms. Seitz is a physicist, will be the Academy's first full-time president. He is on leave from the University of Illinois, where he headed the physics department.

India is negotiating final arrangements for manufacturing the French Sud Alouette 3 helicopter in India. Several American firms are now in the process of negotiating contracts for American firms to receive Indian helicopter orders.

Dr. Frederick Seitz, president of the National Academies of Sciences, was presented the Southwestern Research Society's Langley Gold Medal for "wise and responsible administration" at a dinner of the U.S. technical programs that make possible the conquest of air and space.

## N-156 to Replace Atlas' F-84s

Norfolk N-156 has been selected by Defense Department as standard fighter to be supplied to military units as soon as the Military Assistance Program is replaced for obsolete Republic F-84s still in use.

The announcement marked the end of a contest between Defense Department International Security Affairs Agency, recommending the N-156, and USAF, using selection of the Lockheed F-104-12 (AW May 14, p. 21). USAF 1961 program includes leading for a Military Assistance Program standard fighter. Defense will begin 14 months after approval.

Size of the initial order is not yet known but the total buy is expected to be 380 or 400 aircraft. They will be substantially standardized from the test version now flying. Northing proposed as "optical version" without the control rods or all-weather capability, but there are likely to be variations in test versions with different levels of technology. The defense department is to have some general ideas about other than F-84s in the test version.

# AIR TRANSPORT

Progress Report on Washington's International Terminal: Part I

## Dulles Field Caught in Cost, Time Squeeze

Lags in construction of airport to result in token service on Oct. opening; FAA, airlines differ on fees.

By Robert H. Cook

Washington—Construction of Dulles International Airport, due to open here finally next fall, has been marked by one optimistic cost and time estimate, pressure from a skeptical Congress and the open resentment of much of the airline industry.

The much heralded opening date of Oct. 1, proclaimed by Federal Aviation Agency Administrator Napoléon E. Halabe, is unlikely to result in much more than token airline service, hardly sufficient to justify the elaborate inauguration ceremonies now being planned.

The dedication will climax the photo evidence of the airport which will begin with a planning session by FAA—then the Civil Aeronautics Administra-

tion—24 years ago. Congressional approval of the idea two years later in 1951 resulted in the purchase of 1,300 acres at a cost of \$1 million for an airport site at Herndon, Va. More than six years of bitter political debate followed, resulting in abandonment of the Herndon site at a loss of \$450,000 to the federal government.

Selection of the present Dulles site by then Administrator Elwood B. Quesada was accompanied by an elaborate resolution that the installation would be devoted by mid-1962. This date was later moved to early 1964. As one of his first actions, Halabe, who was highly critical of FAA's handling of the project, set a target date of July 1964 for the opening, only to later cancel the goal to Oct. 1.

Despite ongoing construction progress charts and continuing assurances with prospective airline users, FAA feels

itself in a dilemma of its own making as the scheduled opening date.

Under a strict administration from Congress to complete construction within the limits of a \$105 million budget—excluding \$13.5 million already paid out but contractor claims not yet approved—design changes and inaccurate construction estimates—FAA faces these construction problems:

- **Terminal building construction**, in a \$7.9-million contract awarded to Humphreys and Harding of Washington, D. C. last June, is scheduled for opening completion by Oct. 1, with a penalty of \$5,000 for each day beyond that date.

As of last week, FAA's progress charts indicate that phase is now more than two months behind schedule, primarily due to problems in raising the steel and glass curtain walls of the structure, designed building with the supporting columns of the suspension-type roof. To complete matters further, framing work on the terminal building's 24-inch cooling tower is completed until the

walls of the building are finally in place.

FAA is hopeful that it can persuade the contractor to make the Oct. 1 deadline by increasing work hours or paying overtime, in which case the extra cost would represent a reflection of Humphreys' and Harding's profit on the contract. Should the agency actually direct the firm to take those steps, all extra costs involved might legally be charged to a contractor's claim against FAA, agency engineers explain.

Faced with the Oct. 1 deadline, FAA derives little comfort from the penalty provisions of the contract, since it has stipulations involved, it might be for less credit for a contractor to exceed the completion deadline and pay the penalty than it would to voluntarily increase his work force and hours to meet the deadline.

- **Control tower** completion is about one month behind schedule because of difficulties in attaching the special galvanized metal skin to the top half of the 175-ft high structure. This job, involving the steel work, glass and elevator installations, was originally slated for completion by May 15 but FAA feels that if it is done by mid-June there will be sufficient time for installation of electronic equipment necessary for operation in October. Installation of this equipment was to have started by April 1 as a progress chart which shows an estimated six months for completion.

- **Service building** plans, to the east of the base of the terminal, will house baggage telephones, air conditioning and Weather Bureau facilities. Complete work on this phase is about two months behind schedule, but FAA reports that it is confident the last time can be picked up to meet the contract deadline.



**AERIAL VIEW OF DULLES** shows general field layout. Terminal is located at north end of operational run between two north-south runways. Fuel lines go just to right of right-hand runway. Approach, taxiway, and high-level taxiway lighting is being installed.

behind schedule, but FAA is confident the last time can be picked up to meet the contract deadline.

- **Lighting and sign installation** in the terminal area has also been one month behind, but FAA expects this time can be made up.

On the credit side, FAA reports that even assuming phase of the project is either completed or on schedule. By May 1, a series of major hold orders partly affecting ticket counter and crew rooms space within the main terminal building will have been demoted. Construction is already under way as the more general operational hold orders necessary to begin service and contracts will soon be let for cargo and warehouse buildings and a utility loop to serve the hotel and industrial area plus to be located just north of the terminal.

Airline negotiators, in "collaboration" as they have been dubbed by Administrator Halabe, are both assured and alarmed about these delays. Regardless of Halabe's general optimism or his threatened threats of "superscheduling" to persuade airlines to use Dulles they extend, most of the airlines will schedule operations into the new airport until reasonable and equitable timing for and credit from have been registered.

In view of the construction delays, the airlines consider the Oct. 1 opening date unrealistic because it will require six months to design and finish the rest of such facilities as the apron buildings. They concede, however, that if construction is sufficiently advanced

by June 1, the various flight dispatch, communications and base maintenance facilities might be men enough to complete to permit operations in the four months.

FAA engineers, however, state the airlines have generally estimated four months as sufficient time to complete the work. They also point out that the first finished airport buildings will be available to American and Eastern Air Lines in the west end of the apron.

After back a piece of political debris, and four years of construction, here is what FAA is offering at what it officially calls Washington International Airport and Dulles Airport.

- A 9,500-sq-ft passenger lounge 27 miles from downtown Washington, at Clarksburg, Va., and served by a 17.5 mi. high-speed limited-access highway of four-lane dual design. About 15 mi. of the roadway will be ready for use in October, and night buses for the balance has been acquired. The remaining segment is to connect with Interstate 495, planned for future construction, in the State of Virginia. Total travel time into Washington is estimated at 50 min. which should be reduced to 35 min with completion of the Rt. 66 addition by 1968. Land cost total about \$10 million for the airport site and highway acquisition.

- **Terminal building** is the present two-level design is 190 ft wide by 600 ft long to handle a projected volume of 2.1 million passengers by 1966. Future plans call for extending the structure to 1,300 ft to accommodate 8 million passengers by 1975. Unlike most termi-

nal buildings, passengers will walk less than 100 ft from the main entrance to ticket and baggage check counters, and then directly to one of 24 mobile lounge positions for a five-minute ride to the waiting aircraft.

Aircraft passengers arriving at the terminal will be delivered by mobile lounge to the top-level main concourse, where they can proceed by escalator to the lower level to pick up baggage and then walk out to board ground transportation for downtown Washington. An international arrival area in the southeast section of the building will be expanded in the future. No firm agreement on inter-airline bus yet been reached with any international carrier. Ticket counters for the domestic airlines is also considered adequate at this time, in view of the possible future expansion that may level the need. Total cost of the building is estimated at \$15.5 million.

Local service arrivals and departures will be made through the lower level of the finger extension to the control tower. Taxi passengers have been provided direct in front of the tower base. Space for FAA office and airline clubs is also being provided in the lower level.

About 93% of the Dulles design will require two airline leases and FAA has accelerated the delivery schedule on the 34-million order for 30 hangars so that five will be on hand in October, and the balance by March at the delivery rate of five a month. The hangar now has and typeface text equivalent in three years of operation and each will with the Boeing 707, Douglas DC-8,



**VIEW OF TERMINAL FROM OPERATIONAL AREA**, left, shows 175-ft high control tower surrounded by 20-ft-tall, long fingers. Local service space is in front of tower. Airline's canopy at terminal entrance, right, shows ticket counters near entrance.





# CAB Proposes Stronger Control Of Bilateral Capacity Violations

By L. L. Doty

Washington-Civil Aeronautics Board staff is proposing an amendment to standard bilateral air transport agreements that would authorize government to revoke operating rights of one carrier failing to conform with capacity provisions of such agreements.

The proposal is the latest in a series of attempts by the U.S. to enforce its air transport capacity restrictions on foreign flag carriers serving the U.S. It is, however, the first open move toward overruling bilateral pacts that has been made under the U.S. switched from a policy of freedom of skies to one of capacity control.

Introduction of the amendment into agreements now in effect will require renegotiation of the parts with the countries involved. Thus is the language the Board staff proposes to use in modifying the Bermuda type bilateral agreement.

"Should consultations take place between the two governments concerning capacity, and should these consultations not result in agreed conclusions, each government retains the right to modify or revoke the operating permission with respect to any schedule of an airline of the other party which has been the subject of consultations, and which that government believes could not be operated in conformity with the capacity principles of the agreement. In that event, action to modify or revoke an operating permission would be subject to notification in accordance with

Article 13 of the Air Transport Agreement.

Originally, it was planned to introduce this phraseology into the bilateral agreement with Austria, but talks between the U.S. and that nation soon stalled because the subject of capacity was avoided (AW Apr. 23, p. 21). The proposed amendment is also similar to wording used in the recent exchange of notes with India on the capacity issue.

Primary purpose of the amendment appears to be to provide the U.S. with some form of capacity control without the necessity of going into arbitration. In the past, arbitration has been made available by all nations because it provides no guarantee that a nation's goal can be achieved.

## Local Services

Under the terms of the Bermuda type agreement, either party to the pact may ask for a consultation on the capacity issue when it is felt that an air carrier is operating services in excess of that permitted by the agreement. In 1966, the U.S. attempted to request consultation on Scandinavian Airlines routes scheduled to and from the U.S. through the process of consultation (AW Oct. 16, 1966, p. 42).

This attempt failed because the Scandinavians refused to submit traffic data sought by the U.S. and, in the words of one CAB official, because of "disagreement on the principles involved and a failure on the part of the Scandinavian governments to require SAS to alter its

pattern of operation . . . or even to agree not to further augment its services which the U.S. already believed to be excessive and capricious."

When consultation fails, governments are left with two alternatives: denunciation of the bilateral agreement or arbitration. Neither course was chosen in the SAS case and the dispute with the Scandinavians, and with a number of other nations as well, continues.

## Political Implications

Denunciation of agreement is likely to be frowned upon by the U.S. government. CAB's 1966-67 report, for example, said, "There we have the field of a nation and pick up the problems of political relations with thereby confusion."

Denial to have political relations in terms of bilateral agreements. Nor does Denmark see strong effect in NATO. The same is true of Holland.

Both ILM and SAS have been chief targets of U.S. accusations of bilateral agreement capacity violations.

State Department will get considerable unilateral action against any country with which the U.S. has a bilateral agreement. As a result, it is not likely to back any attempt at denunciation. For the same reason, it may not support any action the CAB takes to amend a bilateral agreement to require consultation on Scandinavian Airlines routes scheduled to and from the U.S. through the process of consultation (AW Oct. 16, 1966, p. 42).

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pattern of operation . . . or even to agree not to further augment its services which the U.S. already believed to be excessive and capricious."

## Arbitration Procedure

Arbitration by a formal committee of one representative of each of the two nations and a third representative named by the first two representatives is permitted under the terms of the standard bilateral air transport agreement. No nation has ever named to arbitration in a matter of settling a bilateral service agreement. Recently France and the Philippines have discussed arbitration to determine their bilateral with the U.S.

A number of government attempts to request U.S. law suit enforcement of government from entering into binding arbitration, and that first that arbitration, under the provisions of a bilateral agreement, is a possible action.

There is a number of reasons why the CAB is reluctant to go to arbitration. It is designed to resolve the consultation provisions and yet permit the enforcement of capacity restrictions without the threat of arbitration. The reason, however, is that the U.S. is not likely to request any U.S. court to force the recovery of capacity limits in consultation.

# Controllers Protesting Punishment Imposed by FAA in Traffic Error

Washington-Punishment proposed by Federal Aviation Agency for the controller who held two airlines over the same fix at the same altitude for 45 min. is considered overblown by many of the 12,000 controllers working in FAA control towers.

The widely publicized incident, which occurred on Feb. 21, involved a United Air Lines Viscount and an Eastern Air Lines Electra. Both cruised at 7,000 ft as a class, holding pattern over Spring Lake, Va., while awaiting clearance to land at Washington National Airport.

FAA has said it will transfer the responsible controller to "a less demanding" location and job, then reducing his pay. Under the government's proposed level of 12 to 15. But according to FAA Administrator N. K. Halibey, he cannot the ATC system is suffering from 15 years of neglect, the agency could not guarantee the accident would not recur.

Commenting on the terms of action, Edward H. Goddard, executive director of the Air Traffic Control Union, said last week that a cause should be sought.

"Let's say that a cause caused a temporary collapse under the stress and strain of his job . . . In lot of pay and position for those unfortunate enough to become involved in such accidents, the answer is not to punish the controller. The answer is to improve the ATC system."

An Aviation News analysis of the controller's reaction in the Washington tower and center indicated that most support Goddard on this issue. Among the questions raised to improve the wisdom of FAA's then disciplinary action toward controllers were:

- Will the man who explains the controller who made the mistake be any more proficient? The controller himself is to be transferred but still will have no experience in the Washington tower, and, until now, an unblemished record. Will FAA's controller corps already undermanned, where can a more qualified replacement be found?

- Is Halibey in a position to make the ATC system rather than the man who is to blame, who is there a need to transfer the controller to another job? Few controllers apparently believe he should be shifted to a less taxing job in Washington and then demand one GS level.

- What takes the accident apart from other near-miss calls that never close in the ATC system? Figures furnished by Federal Aviation Agency for the controller who held two airlines over the same fix at the same altitude for 45 min. is considered overblown by many of the 12,000 controllers working in FAA control towers.

FAA has said that 1,500 near collisions were reported between July 1 and Sept. 30 (AW Dec. 25, p. 50), and that there were 7400 reported aircraft passing within 100 to 500 ft. of each other and 9700 involved aircraft flying into terrain or obstacles.

- Will not the punishment meted out to the erring controller lead to a super controller attitude on the part of other controllers who could make a controller's mistake and the flow of traffic through the ATC system be slowed or made? Halibey, while acknowledging that this is a possibility, does not assume any inordinate controller slow-down.

The major personnel change indicated by FAA after the incident will move pilots on ITR flight plans to maintain their altitude when changing from center sector to sector under air flow one center to another. When altitude is maintained as far forward as the controller can see, the pilots will be advised.

The conflict involved in the holding pattern incident may avoid the transfer and demotion if he decides to do so. Meanwhile, petitions are being filed with the Federal Aviation Board in an effort to persuade FAA that the punishment is too severe and that it establishes a dangerous precedent.

Added to Halibey, the petitions are being filed with the Federal Aviation Board in an effort to persuade FAA that the punishment is too severe and that it establishes a dangerous precedent. Added to Halibey, the petitions are being filed with the Federal Aviation Board in an effort to persuade FAA that the punishment is too severe and that it establishes a dangerous precedent.

In explaining the incident, Halibey did disclose that FAA is seeking whether to transfer to another job or to transfer to another job or to transfer to another job.

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## PanAm to Purchase 2 Boeing 707-320Cs

New York-Pan American World Airways will purchase two Boeing 707-320C jetliners annually for early 1967 delivery and at a price of \$13 million. The 320C, convertible to passenger or cargo configuration, passenger-carrying capacity, will have the same basic airframe and dimensions of the 321B turboprop passenger aircraft, one of which recently was received by PanAm.

According to a spokesman, the cargo door, located forward of the wing on the left side of the aircraft, and beveled up floor and loading gear. Maximum gross weight of the 321C will be 123,000 lb., compared with 117,000 for the 321B.

Consultation for all flights yet only is limited to the Boeing plane, the Douglas DC 8F Jet Trader convertible aircraft, and the L-300, civil designation of the Lockheed C-141 cargo jet ordered by the Air Force. Trans Canada Air Lines ordered Boeing DC 8Fs for early 1967 delivery. The L-300, intended for military end use, is not expected to be available for airline operation before 1966.

PanAm's 321Cs will be powered by Pratt & Whitney JT3D-1 turbofan engines; transatlantic cargo payload is 80,000 lb.

The jet will enter PanAm's "Air Mail" schedule, providing a new service and carrying 120 passengers, 100 cargo, and 100 mail. The aircraft will be used in DC-73C pattern flight operation.

Boeing last week said that it has at least an additional order close to the Boeing 707, but it has not yet placed an order, Boeing said, was a decision on order.

## Examiner Ruling Due On Northeast Control

Washington-Civil Aeronautics Board examiner's decision in the Hughes Twin Northeast Control Case is expected this week. The case involves a dispute between Hughes and Eastern Air Lines.

Rubens said last week, in a dispute between Hughes and Eastern Air Lines, the case involves a dispute between Hughes and Eastern Air Lines. The case involves a dispute between Hughes and Eastern Air Lines.

The examiner's decision would become the decision of the Board 18 days after it was made if no parties file a petition for review. The case involves a dispute between Hughes and Eastern Air Lines.

In this case, petition for review will probably be filed. The case involves a dispute between Hughes and Eastern Air Lines.

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## FAA Development Chief Appointed

Washington-Federal Aviation Agency announced the appointment last week of Robert J. Shuck, formerly vice president of Hughes Aircraft Co., as deputy administrator for development. The position is one that involves a large organization of the agency's headquarters structure.

FAA last week also was expected to announce the formation of an "Aircraft Development Section" under which projects such as Harrier-like and the civil space shuttle. Little Cayman Islands of light plane neighborhood the Lockheed C-141 would be considered. After George, who is currently an director of Civil Aircraft, would be considered. After George, who is currently an director of Civil Aircraft, would be considered.

Reassignment of responsibility estimated to other FAA divisions—principally flight standards, air traffic, aviation research and development and facilities and maintenance, will be under the supervision of the new development section. The new development section will be under the supervision of the new development section.

Shuck formerly was director of Hughes' system research and development division on May 1. He also served by FAA Administrator J. E. Halibey last year as part of a total reorganization of the agency, his new role was filled before. FAAN's 1963 budget report lists his salary at \$173,000 per year.



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He 211B-5, designed to operate over 700 mi. stage lengths, would have a long classical fuselage with wings swept back approximately 10 deg. along the leading edge. Another feature for the engines are incorporated at the ends of the two sections of the V-tail.

## Heinkel Designs Two DC-3 Replacements

By Cecil Browder

Spain, West Germany—Ernst Heinkel Flugzeugbau is offering two new feeder line proposals: one a 34-passenger turboprop, the other a 25-passenger turboprop, at base Douglas DC-3 type replacement, with a particular eye upon German Deutsche Luft Hansa and potential markets in Europe and the U.S.

Aircraft represent industrial refinements of basic proposals drafted in 1935 at the request of the West German Ministry of Economics and are designed to economically cover stage lengths as the 400-700 mi. category and, if either comes into the prototype stage, it would become the nation's first entry in the turbo-powered transport field.

The turboprop design, designated the He 211B-1, provides the most novel design aspects of the two, with two General Electric CF 700-2B jet fan engines of 4,200 lb thrust each installed in parallel in the tail section of the fuselage, between the swept butterfly tail (50° Aft p. 32). Clipping periods

of 22-24 passengers over a maximum stage length of 715 mi. with fuel reserves, the 211B-1 has a cruising speed of 542 mph at an altitude of 20,000 ft. Maximum range without reserves is 2,393 mi. Maximum gross weight is 24,250 lb.

Turboprop proposal, the 211A-1, is a conventional low-wing design carrying 25-25 passengers over a maximum range of 444 mi. with reserves. Without reserves maximum stage is 26,000 ft. at 5,119 mi. at a cruising speed of 180 mph. Proposed port engine and two Landing 175 turboprops of 1,280 hp each. Maximum gross weight is 23,510 lb.

Should the B-1 version go into development, it could conceivably set across the market potential of the Boeing 280, project (Aft p. 48), now under consideration by the U.S. Army particularly within Europe. The 280, with a substantially larger passenger capacity, but also including fuel engine, turboprop, propeller, could be used to service the same type than

last state structures as those envisioned for the 211B-1.

For the present, however, there is little external evidence that either Heinkel proposal stands to gain government financial support, and the company reportedly hopes to find a U.S. industry partner if sufficient interest is shown in one or both of its turboprop and short-haul turbine variants.

Heinkel itself is critical of the lack of support the government has given thus far to efforts to re-establish the West German industry on a sound base by encouraging the development and production of commercial aircraft for the domestic and export markets. After stating that the two present proposals are "studies of projects originally conceived in 1935," Heinkel says:

"In 1935, the German Federal Ministry of Economics approached the national aircraft industry on the possibility of developing plans for the construction of civil aircraft. It was left entirely up to the participating firms to decide whether they should plan to build small sports aircraft or medium- to large passenger machines. It was agreed that the plans would be submitted to the [West German] Deutsche Luft Hansa, which would estimate them on an objective basis. It was further agreed that the Ministry of Economics would make available the capital to develop the projects found suitable by Deutsche Luft Hansa."

"The Ernst Heinkel Co. submitted designs for the development of 30-35 passenger short-haul aircraft with a take-off weight of at least 10 tons. These designs led the identification analysis He 211A and He 211B. Deutsche Luft Hansa gave its approval to the latter plan. The 211B, together with the project of another firm for a large aircraft (a 79-passenger March 9 design proposed by Hannoversche Flugzeugbau).

"Unfortunately, however, hopes that the competition would produce a German civil aircraft went to nothing, and

### Heinkel He 211 Specifications

	A-1 (Turboprop)	B-1 (Turboprop)
Wingspan	77.60 ft.	46.21 ft.
Length	67.55 ft.	62.63 ft.
Passenger load	21-25	22-24
Power/Load	Learning 175	GE CF 700-2B
Empty weight	11,441 lb.	12,127 lb.
Payload	4,850 lb.	4,650 lb.
Max. gross weight	21,610 lb.	24,250 lb.
Cruise speed at 11,000 ft.	446 mph	512 mph
Max. range at 11,000 ft.	—	—
Max. range at 17,000 ft.	—	—
Max. range at 20,000 ft.	—	—
Max. range at 26,000 ft.	—	—
Max. range at 35,000 ft.	—	—
Max. range at 40,000 ft.	—	—
Max. range at 45,000 ft.	—	—
Max. range at 50,000 ft.	—	—
Max. range at 55,000 ft.	—	—
Max. range at 60,000 ft.	—	—
Max. range at 65,000 ft.	—	—
Max. range at 70,000 ft.	—	—
Max. range at 75,000 ft.	—	—
Max. range at 80,000 ft.	—	—
Max. range at 85,000 ft.	—	—
Max. range at 90,000 ft.	—	—
Max. range at 95,000 ft.	—	—
Max. range at 100,000 ft.	—	—
Max. range at 105,000 ft.	—	—
Max. range at 110,000 ft.	—	—
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Max. range at 250,000 ft.	—	—
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## Trans World Airlines' all-new *StarStream*

An entirely new breed of jet "StarStream" is all-arc, starting with the engines, built by Boeing especially for Dynaflex jet power. It adds new dimensions to the pleasure of flying—new range, new smoothness, new comfort. Cruising at over 40 miles a minute, you scarcely feel you're moving. Extra soundproof cushioning puts you in a new land of quiet. Beyond questions, StarStream is the most advanced of jetliners, with new capabilities of speed: five Dynaflex jet engines delivering over 70,000 pounds of thrust. StarStream is in service now, coast to coast. Welcome aboard for a wonderfully new experience in flying.

STARSTREAM and DYNAFLEX are service marks owned exclusively by Trans World Airlines, Inc.



public funds have not yet been put up to launch the program."

While Lockheed originally gave the nod to the tailboom, Hinkle ran an several operating efficiencies, gained by the introduction of the CF 700 sh fus engine and other improvements ran give the 111B-1 tailboom a clear short-haul advantage except in instances where short takeoff and landing capability is a necessity.

The 1978 proposal—the 111B—was built around three 1,400-hp General Electric JT5 turbojet power plants configured along the same fuselage as the engine installation for the Boeing 727 and the McDonnell Douglas DC-121 jet transport—one podded on either side of the air fuselage the third located in the tail with its inlet protruding from beneath the vertical fin. Carrying passenger loads of between 90 and 11 passengers, the four-engine 111B had a design cruise speed of 700 mph at 30,000 ft.

Maximum range with full reserves, however, was only 350 mi.

In selecting its design, Hinkle attempted to fit these into a market where competitive aircraft did not steadily hold sway and decided upon aircraft that might have sales potential in hot market cases.

• **Schedule air services** where income depends upon passenger miles flown, in particular letter services and short-haul traffic on domestic and foreign routes.  
• **Charter traffic**, services to casual users, etc.

• **Large individual firms** operating as fleets, aircraft.

• **Service operated** by state authorities (military, air, VFR transport, etc.).

This combination of factors led the company in its present design scheme, short-haul plan (limited passenger loads at manageable operating costs. To obtain the necessary economy, Hinkle decided upon a low drag design with a relatively small fuselage weight for both the tailboom and tailboom developments plus high wing loadings to avoid increase cruise altitude requirements over short ranges. Fuel efficiency need for high daily utilization rates also was taken into consideration.

Major factors include lower fuel consumption at holding altitudes with the net from three to two engines—58 lb per seat at 70,000 ft for the JT5-powered B as compared with 77.5 lb for the B-1—and a resultant drop in reserve fuel requirements upon arrival over the terminal airport. The additional power gained in the powerplant shift has permitted a 1-ft stretch of the fuselage to 62.5 ft.

The band engines, with relatively small nacelle intakes, plus adoption of a butterfly tail as a substitute for the conventional vertical fin on the B model also have resulted in low drag and a more spacious cabin in speed and range according to Hinkle.

Accident statistics are protected from possible ground ingestion by protective side panels that automatically retract into the tail section when the triangle

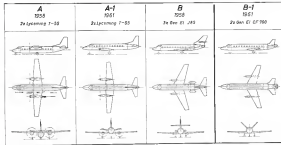
loading gear folds back into the wing bay. The tail boom loading 6,614 lb is stored internally in the wing and in two standard auxiliary tanks podded beneath the mid-wing sections.

Number of passengers that can be accommodated depends upon the seat utilization. If they are positioned 18 inches forward, there is space for 22 seats in a two-aisle configuration along both sides of the aisle. Another two can be added for a total of 24 if the seats are placed so that they incline 15 deg toward the aisle. To gain additional luggage cargo space, the first four seats also can be inclined.

Major changes in the A-1 tailboom have in 1978 performance involve the switch from high to low-wing design.

A low-wing design approach was decided upon to permit use of large diameter propellers for maximum short takeoff performance—1,130 ft as compared with 1,755 ft for the A-1. When Lockheed gave relatively little weight to the short takeoff aspects in its original evaluation of the competing intakes, Hinkle shifted in the low-wing configuration, a move that provided weight savings through a lightening of the landing gear structure, a thinning in the engine nacelle housing and a simplified construction through use of cruciform nacelle ribs.

The new configuration also boosts normal cruise speed at 11,000 ft altitude from the former 552 mph to 410 mph for the A-1. On both models, all fuel is stored internally in the wings.



**THREE-VIEWS** show general design changes in the Hinkle 111 series of tailboom and tailboom short-haul aircraft proposed between 1975 and late 1976. Major design changes between the A and A-1 tailboom models involve shift from a high wing on the 1975 jet pod to a low wing design on the late A-1. Another major change involves the use of five General Electric JT5 propellers, one podded on each side of the fuselage, the third located in tail section. Later B-1 has two GE CF700-3B's located in parallel at tail between butterfly fin sections.



## THE SHORT HAUL JET

# WITH MAIN-LINE FEATURES

- Big-jet standards of comfort PLUS the passenger-appeal of latest jet design in an advanced rear-engine configuration.
- Spacious cabin of big-jet dimensions: 10 ft 4 in wide at arm-rest level. More room per seat than in current big-jet 6-abreast layouts.
- Carries up to 60 passengers in roomy 5-abreast seating at 23-in pitch.
- Separate forward and aft passenger entries, toilets and galleys permit complete class separation.
- Close-pitched 54-in high cabin windows provide excellent aerial views for all passengers whatever the layout.

BAC

JET SUCCESSOR TO THE VISCOUNT WITH EVEN BETTER THAN VISCOUNT ECONOMICS

# ONE-ELEVEN

TWO ROLLS-ROYCE SPEY TURBOFAN ENGINES

### BRITISH AIRCRAFT CORPORATION

ONE HUNDRED RALL MALL, LONDON SW1, ENGLAND  
USA: BRITISH AIRCRAFT CORPORATION (USA) INC.,  
200 JEFFERSON DAVIS HIGHWAY, ARLINGTON, VIRGINIA



## NEW! ON WESTERN AIRLINES

NEW!

Nonstop service between San Francisco and Las Vegas

NEW!

The only one-plane thru-service from Seattle/Tacoma and Portland to Las Vegas

NEW!

Fastest nonstops between Los Angeles and Sacramento, via Jet/Prop Electra II's

NEW!

Fastest daily flights between Los Angeles and Reno, via Jet/Prop Electra II's

NEW!

Fastest flights between Reno, Sacramento and San Diego, via Jet/Prop Electra II's

NEW!

Fastest flights and lowest fares between Sacramento and Reno

NEW!

Daily nonstops from San Diego to San Francisco

NEW!

Only nonstop flights between Long Beach and San Francisco

## Boyd Urging New Short-Haul Transport

Civil Aviation Board Chairman Allen S. Boyd last week outlined specific reasons for a short-haul transport aircraft which he urged industry to develop—with government assistance if necessary.

Boyd envisioned a 24-passenger aircraft seating less than \$100,000, that could operate over local service routes of 500 mi. with four intermediate stops and one refueling.

Stressing the immediate need for a Douglas DC-3 replacement, Boyd said that the Board would probably not get involved for the project if no more factors were willing to undertake the task with its own resources. Boyd speaking in Seattle before the Society of Automotive Engineers, said he believed there is a ready market for well over 100 such aircraft.

Here are the specifications Boyd outlined for the aircraft which he said is necessary to induce subside needs of U.S. local service airlines.

- Aircraft should accommodate no more than 24 passengers, but should have adequate space for baggage and 1,000 lb. of cargo, preferably in space that cannot be converted to additional passenger seats.

- Fuel capacity should be sufficient to permit four intermediate stops on stage lengths of 500 mi. with no more than one refueling.

- No more than 4,000 ft. of terrain should be required and, if possible, seek the down to zero capability and no vertical take-off.

- Price, including essential electronics, should be less than \$100,000 and "hopeful" under \$50,000.

- Selection of powerplant is "important" as in the speed, but direct operating cost including depreciation must be under 60 cents per plane mile at an average stage length of 80 statute miles. When the cost comes too heavy, they need not show above the 250 and stage length. It is the area between 80 and 150 mi. that is important for this plane.

Boyd attempted to allay any fear that manufacturers may have over a hot market resulting from government withdrawal of subsidy. He said that if an aircraft service really serves 400 cities on 45,000 route miles using 216 Douglas DC-3 aircraft, and added: "Then, DC-3 will be replaced. It is repeated, unavoidable and certainly profitable to assume that government support of the overall service of these carriers will be somewhat diminished even though the reduction [of subsidy] will be phased with changes."

Boyd said that aircraft being relegated into local service fleets were not

designed to be efficient under operating conditions in which they are being placed. He said the DC-3 was inefficient in a phase-out from local service routes and then sold.

"It is possible that the angle of the DC-3 cannot be repaired," he added, "but it is difficult to accept the idea that after more than 25 years the industry is to replace this venerable plane in its build or design. I believe the engineering what is possible in use of several aircraft carriers in this country to accomplish this task."

Boyd called upon the engineer and economist to cooperate more closely in the design and development of new aircraft which will give the economic results. It is the obligation of the engineer to use his ingenuity to design an airplane that will do the job. It is the obligation of the economist to determine the operating costs as well as developmental and production costs. Together he and one holds a veto over the other.

Boyd turned again to training of local service pilots after expansion of the use of larger equipment to handle such routes. He said:

I would remind the local service

### Transport Contenders

At least three manufacturers are jockeying for local service in development that might fit the general specifications in outline of the airplane that is outlined. They include:

- Fairchild Aircraft Corp., which is presently the Fairchild-developed transport aircraft in service with local service airlines as an alternative to the 24-passenger airplane for local service, or the modified low-level carrier. Fairchild is considering that a quad-engine configuration (E2) is noted in this segment and cheaper than developing a new personal transport aircraft.

- Cessna Aircraft Engineering Corp. is building a 24-passenger version prototype of its own two-engine C-440 and plans to have it certified by Sept. 1. The airplane, which will be equipped with a single engine, is based primarily on a replacement of the DC-3, and to U.S. economic reasons, a program that was not from the Fiscal 1965 budget, but which still may be needed.

- Fennell's Fennell through its U.S. subsidiary, Turbo-Flight Inc., is proposing a 24-passenger high altitude subsonic and version of the four-engine Fennell 540 to local service airlines. Don Fennell, Turbo-Flight president, reports no interest on the part of Civil and Coast Airlines and no airline interest.

even if that portion of their permit certificate which says in part "that the present purpose of this certificate is to authorize and require it to offer scheduled, local or feeder or non-scheduled service."

He added that he was confident that Board members intended that such a policy be continued and that carriers will "not be allowed of their accepted obligations because they may have acquired or intended to acquire equipment essential to services found to be required in the public interest."

He explained the time needed for such studies and this included that it "would be inconsistent with the goal of subsidy, including to encourage underwriting equipment, used for such studies and long-range operations, that might be required for the purpose of comparing with airlines in local service markets."

### Thai Airways to Begin 990 Service in May

Stockholm—Thai Airways International will begin operating Convair 990 medium-range jet transports over its routes for London route approach by getting May 15 under terms of a recently signed and worked agreement with Scandinavian Airlines System (SAS) (p. 3).

Although officially described as a "lease-purchase agreement," the arrangement with SAS is in the form of an equipment out-lease during its initial stage at least. Under present plans, SAS will offer twice-weekly service to Tokyo with the two monthly, revised 990s that are leased from Stockholm. When an aircraft arrives in Tokyo, it will be turned over to TAI which will fly it over its route structure to Taipei, Hongkong and Bangkok.

The aircraft will then be flown back over the route to Stockholm. TAI also turned over to SAS for the return flight to Stockholm, although TAI also hopes to schedule 990 service from Bangkok to Singapore and Jakarta on a leased basis.

Net effect of the arrangement will be to bolster the competitive position of TAI of which SAS is a 30% owner, as well as increase the visible utilization rate of the aircraft. Because of 990 delivery delays, SAS delayed Douglas DC-8s to its Far Eastern routes and now plans to return them on those segments. The twice-weekly 990 schedule, it is hoped, will also support other route expansion and would the TAI exchange the utilization rates would be profitable low.



## New Shell designed refueler "inspects" every drop of fuel it delivers—can pump 600 gpm to reduce fueling time

Shell has designed a new refueler that can pump 600 gallons of fuel per minute, "inspects" it for cleanliness and can shut itself off automatically to help ensure outstanding quality. It even has a "gold-fish bowl" cab (see picture) for maximum visibility.

Read how its maneuverability, front-end refueling system and built-in elevator help make this vehicle exceptionally safe, efficient and simple to use.

**T**een pictures on the left shows the business end of Shell's new 30,000-gallon refueling truck.

Aircrews are happy with the new refueler because it helps them reduce costly ground time for their jets. Here's how: Each refueler can pump 600 gpm of jet fuel's insurance. Working as a team, two units can refuel an aircraft—20,000 gallons—in 17 minutes.

The refueler's low clearance line is maneuvered with ease into refueling position between an open pair.

The new Shell truck's cab even has a coat of glass, allowing the driver to position the truck safely and easily.

### Front refueling for efficiency, safety

Refueling is done from the front of Shell's refueler. There is less chance of accident.

The new truck even has an elevator (the pumping platform is hydraulically operated). This makes it easier to hook up refueling hoses to a plane. Each truck has a special filter-separator. It is

designed to meet strict military specifications for fuel cleanliness—and the even stricter specifications imposed by Shell aviation customers.

Precautions are taken against dirt or moisture all along the line, whenever fuel is transferred from one container to another—from refinery to tank large to storage tank to truck to aircraft.

### Checks and double checks to prevent accidents

It's highly unlikely that water could get into the new refueler. But if it should, this remarkable unit is designed to prevent it from getting into an airplane's tank. Each refueler has a highly sensitive water slug device. If it detects water in the fuel, a filter-water separator slug valve can stop the pump in half a second.

The "deadman's control" is another safety device. It allows operation by remote control, and gives the operator freedom to observe the entire fueling operation from the best location.

Should trouble occur, the "deadman's control" can also stop the pump.

### More automatic features

Pumping platforms are retracted automatically. The truck's brakes lock automatically when the pumping operation begins. They cannot release until pumping is finished and the hose is returned to its retractor in the truck.

There are just a handful of the many features Shell has designed into this remarkable truck. They give you an idea of how much imagination and care Shell and its dealers invest to serve aviation better.

For full information on Shell's aviation products and services—including refueling developments—write: Shell Oil Company, 50 West 53rd Street, New York 20, New York.



Shell is the nation's leading supplier of commercial aviation products and has been for more than a decade.

◆ New Shell designed refueler, left, struggles between the push and under the wing of aircraft. Then of these refuelers operating simultaneously can refuel a jet in 17 minutes or under.



How you can operate more reliably... more economically... with these first proofs of the Solid State generation in airborne electronics.

Collins' use of microelectronics now brings you the 162-A Master Design and 1174A Globallogic Radconcom — first of a line of Solid State Systems that mean big savings to you. ■ They are smaller than any other. ■ They are lighter than any other. They require less power than any other. They are more rugged than any other. ■ They operate as well as Collins Solid State Systems — the circuit architecture that makes Collins first choice in airborne electronics. ■ Contact us today for complete information. Collins Radio Company • Cedar Rapids • Dallas • Los Angeles • New York



## SHORTLINES

■ **Air Transport Assn.** reports U.S. airlines flew 2.66 billion (percent) passenger miles during March, bringing the 1962 first quarter total to 7.60 billion. The figure represented increases of 11.6% and 36.5% over the same period last year, but last year's figures were low due to strikes.

■ **Alaska Airlines** reports a 57% increase in passenger traffic in both directions across the North Atlantic during the first quarter of 1962, a period when seating capacity rose by 44%. The airline carried a total of 15,157 passengers between U.S. and Canadian gateways and London, Milan and Rome during the first quarter.

■ **American Airlines** reports it flew 692,800 passengers \$84 million revenue miles in March—a gain of 4% and 1% respectively over last March.

■ **British West Indian Airlines** has asked CAB to approve reduced 17 day extension rules between New York and Antigua, Barbados, Trinidad and Tobago. BWAIA also asks approval to select seven routing 10 day extension fares from both New York and Miami to Caribbean points. Current restrictions since 1955—would be New York-London, bringing the new fare to \$199 from \$245. Plan would become effective May 18 if CAB approves.

■ **CAB** hearing in the Aeromex-Easton air traffic dispute application is set for 10 a.m. May 16 at 401 W. 75th St. in Washington.

■ **Central Airlines** has asked CAB to approve special low-cost round-trip fares between 76 pairs of non-competitive points on its system. The rates, to be called "Bargain Fares" will enable round-trip passengers to fly return legs at 25% of the regular one-way fare within four days of departure.

■ **Korean Air Lines** will increase its New York to San Juan Puerto Rico service DC-4 flights from two to five flights daily, April 19 and from five to six flights daily on July 1. The DC-4s, in 134 seat configuration, will replace DC-6B aircraft.

■ **Trans World Airlines** reports first quarter revenues of \$68.1 million—high as its history, according to TWA. Pre-tax losses for the period were \$14.3 million, compared with \$16.6 million for the same time last year. However, after tax losses totaled \$17.4 million for the period, compared with \$5.3 million last year.

## AIRLINE OBSERVER

■ **Watch** for Federal Aviation Agency to meet that the controversial air-traffic procedure governing takeoffs from Idlewild Airport's Runway 31L be made less complicated. Meanwhile, FAA Administrator N. E. Hilditch has appointed George Prill, director of the agency's Flight Standards Service, as interim head of the FAA team that is to study the cause of the Mar. 1 crash of an Aeromex Airbus' 707-123B at Idlewild. FAA investigations under Prill included even possible cautions the Americans jet could have encountered after departing Runway 31L, but failed to find any significant clues. But Prill and Hilditch hope to draw a sampler soon to learn the Idlewild area than the present 31E procedure (AW Apr. 16, p. 35).

■ **Canada** will build 10 CL-44 turboprop cargo transports in addition to those already built under firm order. Production rate will be one per month as a means of keeping production lines open. Five of the 10 are expected to be purchased by the Canadian government for the RCMP and the others will be built as individual orders. Lack of orders is expected to result in severe personnel cutbacks which may reach as high as 40% of Canada's work force by the end of the year. Expected government order for 100 CL-44 jet trainers has not yet been received and almost half of the order for 200 CL-44As has been completed.

■ **Look** for legislation to increase insurance that may be borrowed from the British Treasury by British Overseas Airways Corp. and British European Airways, the two state-owned airlines. The increase is needed to finance equipment—like Havilland Tridents for BEA and Vickers VC10s for BOAC—and to meet loans authorized by both carriers for the current fiscal year.

■ **FAA's** Aviation Research and Development Service is losing interest with industry for failing to stage ground tests of air traffic control system hardware used to the agency's Atlantic City, N. J., experimental center for evaluation. According to some major manufacturers who contact with FAA, the service is often vague on the status of particular projects and sometimes employs a technique of "decision by inaction" to put an end to others.

■ **San Francisco & Oakland Helicopter Airlines** has accepted delivery of a third Sikorsky S-62 helicopter to accommodate growing traffic volume in the San Francisco Bay area (AW Oct. 30, p. 31). Carrier is now handling about 7,000 passengers per month and expects to show its first profit in May.

■ **Lufthansa** has submitted a memorandum to the Civil Aeronautics Board investigation of foreign air carrier permits which states that, under German law, the Federal Republic cannot make a unilateral change in the interpretation of its bilateral agreements with U.S. The same states that Germany has always interpreted the bilateral as prohibiting other governments from regulating capacity, but adds that German law provides this instance where interpretation could be changed "... should the U.S. ever purport to find authorization in the agreement for unilateral capacity control, the Federal Republic will be free to make the same discovery."

■ **New** model of staff cutting indicates that Aeroflot may be having difficulty finding passengers to fill its rapidly growing number of available seats. The Russian carrier is late April indicated weekly around 13,000 on 12 routes, including Leningrad-Odessa, Tbilisi-Kyivgrad, Leningrad-Moscow, Odessa, Almaty-Novosibirsk, and Novosibirsk-Sverdlovsk. On a number of additional routes Aeroflot extended winter season and other promotional fares until next October.

■ **Most** members of the Air Line Pilots Assn., board of directors are expected to arrive in Miami May 29 with no intention from their local council on whom to support for the union's presidency. TWA's master executive council endorsed the qualifications of Capt. John C. Carroll, ALPA first vice president, and National Council endorsed Capt. Charles H. Kelly, second vice president, but these endorsements are not binding on the approximately 300 board members who will elect the union's president.

# Turbine Aircraft 1961—Cents per Revenue Mile



**SLUG FIRING.** Sequences photos show America's first sub-fitted intercontinental ballistic missile, Minuteman, blasting out of underground silos at Cape Canaveral, Florida. This U. S. Air Force missile, developed as an "assured destruction" in terms of procurement and maintenance costs, is simple, compact, quick

firing. Minuteman missiles will be stored underground at sites hardened against nuclear attack. Boeing air weapon system integrates, inseparable for Minuteman armament, test, launch control and ground support. The Minuteman ICBM weapon system will be operational later this year, a year ahead of original schedule.

## Capability has many faces at Boeing



**DISTANCE CHAMP.** A Boeing B-57D missile bomber can now reach distance record, flying 11,416 miles from Okla. to Spain, non-stop, without refueling. This Strategic Air Command B-57D demonstrated the global reach of the missile-bombing Boeing B-57D.

**GLEAM ROOM.** In super-clean room, Boeing Minuteman missile ingested stage and first Minuteman 1000 Bore guidance system on engineering and manufacturing activities.



**WATER, WATER.** New U. S. Army jet has four and two Boeing gas turbine engines to drive two props, each pulling 2000 pounds of water a minute. Thrusters weigh 225 pounds each, deliver 270 hp. Tough, diesel Boeing turbines also power U. S. Navy autonomous tug, launches, gunboats, and personnel boats.

**BOEING**

	Flying Operations	Flight Maintenance	Tab-Total	Operations & Bunkies	Total Flight Expense	Revenue Airfare Mile
<b>BOEING 707</b>						
American	87.37	54.81	132.18	31.05	163.23	38,859.9
Boeing	138.78	82.18	220.96	45.14	266.10	4,188.7
Continental	84.34	55.29	139.63	34.35	174.00	12,319.2
Northwest	138.34	18.12	156.46	23.44	179.90	45,416.9
Trans World	78.37	28.37	106.74	27.64	134.38	45,899.4
Western	84.28	15.83	100.11	32.23	132.34	3,388.2
<b>707 Average</b>	107.28	28.58	135.86	33.58	169.44	
<b>BOEING DC-8</b>						
Delta	133.35	45.45	178.80	33.34	212.14	7,219.3
Eastern	138.89	33.84	172.73	30.19	202.92	15,370.3
Northwest	78.47	18.18	96.65	27.64	124.29	3,772.7
Southwest	117.41	34.42	151.83	42.63	194.46	7,446.3
Panair	135.92	18.43	154.35	50.88	205.23	5,919.7
Trans World	115.38	34.33	149.71	34.85	184.56	31,084.4
Trans Continental			Not Filed			86.7
United	92.20	29.97	122.17	37.87	160.04	55,281.8
<b>DC-8 Average</b>	121.76	34.91	156.67	40.45	197.12	
<b>BOEING 737</b>						
American	89.77	28.33	118.10	39.83	157.93	25,444.9
Boeing	78.63	32.41	111.04	34.34	145.38	2,327.3
Eastern	79.13	11.13	90.26	49.37	139.63	2,330.8
Northwest	88.81	27.20	116.01	47.83	163.84	8,834.4
Trans World	64.88	18.48	83.36	32.41	115.77	1,385.3
United/Continental	70.33	31.48	101.81	45.34	147.15	30,188.3
Western	87.34	43.28	130.62	34.87	165.49	1,891.8
<b>737 Average (Boeing Excl.)</b>	86.83	30.24	117.07	40.38	157.45	
<b>BOEING 740</b>						
American	139.34	21.07	160.41	43.07	203.48	204.9
Boeing	84.84	28.87	113.71	38.17	151.88	5,631.8
Northwest	88.11	33.42	121.53	41.78	163.31	3,891.7
Trans World	82.78	31.82	114.60	42.28	156.88	34,893.7
<b>740 Average</b>	87.84	27.58	115.42	41.84	157.26	
<b>BOEING 747</b>						
American	33.36	19.56	52.92	40.46	93.38	1,133.1
<b>BOEING CL-44</b>						
American	81.20	32.04	113.24	47.10	160.34	1,705.2
Boeing	121.78	81.88	203.66	48.15	251.81	264.9
<b>CL-44 Average</b>	86.73	36.49	123.22	47.78	171.00	
<b>BOEING 767-300</b>						
American	33.36	22.11	55.47	22.35	77.82	1,395.3
<b>BOEING 767-400</b>						
American	90.89	38.47	129.36	47.20	176.56	4,891.1
Boeing	79.67	30.61	110.28	41.84	152.12	4,641.1
Eastern	77.67	11.81	89.48	48.17	137.65	33,431.8
Northwest	88.13	26.85	114.98	44.11	159.09	8,702.3
Trans World	77.83	37.87	115.70	42.28	157.98	5,294.1
Western	80.00	43.38	123.38	48.15	171.53	7,133.1
<b>Boeing Average</b>	87.87	40.24	128.11	45.26	173.37	
<b>BOEING 777-300</b>						
American	33.36	19.56	52.92	40.46	93.38	1,395.3
Boeing	33.36	19.56	52.92	40.46	93.38	1,395.3
Continental	33.36	19.56	52.92	40.46	93.38	1,395.3
Northwest	33.36	19.56	52.92	40.46	93.38	1,395.3
Trans World	33.36	19.56	52.92	40.46	93.38	1,395.3
United	33.36	19.56	52.92	40.46	93.38	1,395.3
Western	33.36	19.56	52.92	40.46	93.38	1,395.3
<b>777-300 Average</b>	33.36	19.56	52.92	40.46	93.38	
<b>BOEING 777-400</b>						
American	33.36	19.56	52.92	40.46	93.38	1,395.3
Boeing	33.36	19.56	52.92	40.46	93.38	1,395.3
Continental	33.36	19.56	52.92	40.46	93.38	1,395.3
Northwest	33.36	19.56	52.92	40.46	93.38	1,395.3
Trans World	33.36	19.56	52.92	40.46	93.38	1,395.3
United	33.36	19.56	52.92	40.46	93.38	1,395.3
Western	33.36	19.56	52.92	40.46	93.38	1,395.3
<b>777-400 Average</b>	33.36	19.56	52.92	40.46	93.38	
<b>BOEING 787-9</b>						
American	33.36	19.56	52.92	40.46	93.38	1,395.3
Boeing	33.36	19.56	52.92	40.46	93.38	1,395.3
Continental	33.36	19.56	52.92	40.46	93.38	1,395.3
Northwest	33.36	19.56	52.92	40.46	93.38	1,395.3
Trans World	33.36	19.56	52.92	40.46	93.38	1,395.3
United	33.36	19.56	52.92	40.46	93.38	1,395.3
Western	33.36	19.56	52.92	40.46	93.38	1,395.3
<b>787-9 Average</b>	33.36	19.56	52.92	40.46	93.38	
<b>BOEING 787-10</b>						
American	33.36	19.56	52.92	40.46	93.38	1,395.3
Boeing	33.36	19.56	52.92	40.46	93.38	1,395.3
Continental	33.36	19.56	52.92	40.46	93.38	1,395.3
Northwest	33.36	19.56	52.92	40.46	93.38	1,395.3
Trans World	33.36	19.56	52.92	40.46	93.38	1,395.3
United	33.36	19.56	52.92	40.46	93.38	1,395.3
Western	33.36	19.56	52.92	40.46	93.38	1,395.3
<b>787-10 Average</b>	33.36	19.56	52.92	40.46	93.38	

7-97 Average  
\*Year Ending Sept. 30, 1961

### Turbine Powered Aircraft 1961 Operating Expense

	2" FING OPTIMATIONS				
	Cross Expander	Apex .001 & Tapers	Recesses	Other	Total
<b>SOBING TIT</b>					
American	126 .48	326 .45	41 .87	3 .33	493 .89
Brazil	118 12	346 31	46 .33	6 .37	471 12
Continental	121 19	336 23	44 .25	6 .54	464 37
For American	173 .45	315 .49	31 19	1 00	391 33
From World	166 .48	359 37	37 19	6 73	448 19
Wetland	132 34	343 39	31 30		438 39
<b>2" F Average</b>	<b>136 .60</b>	<b>349 39</b>	<b>39 29</b>	<b>1 34</b>	<b>454 38</b>
<b>BOULGAN BCB</b>					
2" for	116 12	342 33	41 23		401 19
Brazil	132 31	337 31	47 .66	8 24	471 32
Norland	98 91	325 47	36 79	4 43	368 10
Northwest	102 44	311 14	44 91	1 50	361 15
Passage	101 41	349 30	320 19	14 09	436 79
For American	174 10	326 70	37 18		321 78
From Continents			Not Used		
Others	120 18	319 34	31 20	8 37	403 38
<b>2" B Average</b>	<b>141 49</b>	<b>372 10</b>	<b>45 64</b>	<b>8 76</b>	<b>461 53</b>
<b>SCORING TIB</b>					
American	128 00	311 30	44 73	3 43	394 02
Brazil	97 75	334 73	46 20	6 45	420 81
Europe	98 91	334 70	46 50	6 50	399 48
Northwest	102 92	314 39	49 79	1 82	393 88
From World	146 31	312 80	41 89		421 10
South (Caydon)	119 92		39 19	8 44	376 40
Wetland	79 02	317 33	34 58		326 12
<b>2" D Average (Braz. Excl.)</b>	<b>109 75</b>	<b>329 46</b>	<b>44 89</b>	<b>3 68</b>	<b>389 15</b>
<b>COMBING BCB</b>					
American	96 25	342 88	314 13		441 13
Brazil	123 38	319 74	44 16		407 28
Northwest	99 13	317 87	48 43	8 13	387 87
From World	153 38	314 91	55 50	6 79	378 48
<b>2" D Average</b>	<b>124 96</b>	<b>317 91</b>	<b>42 31</b>	<b>8 45</b>	<b>403 67</b>
<b>SUB CARABOL</b>					
2" for	61 47	37 44	32 03	1 72	127 07
<b>CANADIAN C-14</b>					
Flying Tiger	81 11	39 33	44 14		120 42
Declined	154 41	37 36	47 93	4 07	301 87
<b>C-14 Average</b>	<b>89 34</b>	<b>38 41</b>	<b>49 54</b>	<b>8 45</b>	<b>261 87</b>
<b>AM 490 ABBOT</b>					
Brazil	28 44	29 31	33 55	3 04	74 34
<b>DOCKED ELECTRA</b>					
American	107 14	78 47	11 20	1 20	197 47
Brazil	79 12	79 44	33 72	8 45	188 11
Europe	117 67	74 26	37 79	10 18	203 81
Northwest	88 45	79 47	19 54	6 50	179 65
Southwest	302 34	81 43	33 12	1 13	393 30
Wetland	93 42	79 48	32 49	6 01	181 80
<b>Electra Average</b>	<b>102 46</b>	<b>78 56</b>	<b>37 29</b>	<b>8 76</b>	<b>195 34</b>
<b>WICKERS WESCOUT</b>					
Continents	81 25	34 33	4 49	8 01	124 75
Northwest	23 43	24 45	70 40	8 28	116 56
Others (Excl.)	74 44	64 09	5 50	8 15	134 30
<b>Wescout Average</b>	<b>81 18</b>	<b>34 56</b>	<b>4 70</b>	<b>8 08</b>	<b>138 27</b>
<b>BLANK COMBAT</b>					
2" for	18 11	29 73	17 10	1 15	126 08
<b>PROBING P-17</b>					
2" for	50 90	40 14	11 23	8 08	90 35
Europe	47 44	34 33	10 73	8 15	91 85
For Continental	53 33	41 49	78 27	8 18	130 37
Others	49 00	39 45	11 73	8 08	88 28
Profts	49 35	32 21	10 94	3 40	97 90
For Asian	47 44	33 82	10 54	2 24	92 32
Wet Coast	48 15	34 58	16 86	8 00	94 40
Wet Africa	48 25	42 27	37 92	1 27	140 41
<b>P-17 Average</b>	<b>49 19</b>	<b>39 44</b>	<b>38 64</b>	<b>8 09</b>	<b>97 40</b>

<sup>3</sup> *Free Inquiry*, June 20, 1991.

## –Dollars per Total Aircraft Hour

	DIRECT MAINTENANCE				Papers Permitted to Manufacture	Spare Parts & Materials	Total Expense	Total As to Revenue
	As Permitted	Expenses	Other Expense	Total				
<b>SHINGO 707</b>								
Aluminum	76.46	73.31	13.45	163.28	168.37	134.76	769.89	46,436
Steel	23.70	11.84	4.84	75.38	47.12	203.86	996.32	5,281
Copper	44.83	86.24	10.79	141.93	126.29	113.69	471.38	23,582
Per Alloy	70.20	83.99	13.33	172.52	48.16	246.66	660.16	35,346
Woven	41.40	74.86	10.76	127.02	117.46	215.88	875.00	47,000
Wires	27.81	113.27	4.24	132.33	276.49	268.34	743.73	3,804
<b>PER BARBER</b>	78.97	41.16	16.34	136.47	437.37	283.72	821.29	
<b>BOUGLAS 803</b>								
Ducks	47.79	106.49	2.93	157.21	450.23	259.80	861.52	16,844
Brakes	46.31	41.73	16.14	104.17	426.97	217.79	841.76	38,427
Horizontal	52.32	51.80	12.44	116.56	227.32	177.46	720.77	17,175
Per Alloy	40.71	90.94	10.38	141.74	705.34	293.41	896.45	16,438
Transfer	346.19	73.23	16.39	435.81	1,101.72	330.82	1,332.26	6,292
Woven	83.42	60.25	31.29	174.96	456.41	203.97	644.42	36,468
Power Cables								
Unit	57.83	46.40	12.93	117.16	208.16	179.38	727.22	111,009
<b>BE-B Average</b>	70.92	47.13	16.24	134.29	429.18	268.55	696.88	
<b>SHINGO 725</b>								
Aluminum	47.64	73.13	4.87	125.63	319.87	181.86	761.45	44,729
Steel	50.48	45.13	3	98.61	142.86	150.15	769.56	4,041
Brakes	17.91	19.34	3.93	39.18	345.21	141.20	361.26	7,493
Horizontal	38.84	78.84	9.79	127.47	417.37	237.62	724.40	6,724
Power Wires	55.45	164.44	10.38	230.27	459.56	567.91	1,027.47	7,841
Unit/Coil	50.94	41.47	12.73	105.16	320.16	181.79	711.89	46,307
Wires	49.07	123.76	8.24	181.07	475.81	183.05	764.93	6,357
<b>PER BARBER (Permitted Revenue)</b>	46.75	42.78	9.34	100.87	201.79	184.22	736.07	
<b>CONWAY 850</b>								
Aluminum	50.16	112.69	5.71	168.56	614.57	384.79	753.36	3,113
Steel	78.40	12.44	7.83	118.67	226.28	177.46	421.20	21,774
Per Alloy	129.50	100.97	11.47	241.94	424.81	271.79	966.43	13,804
Power Wires	76.03	158.45	12.30	346.78	439.34	218.45	841.77	35,431
<b>PER BARBER</b>	54.50	100.55	9.37	164.42	398.76	201.56	644.36	
<b>SUB CARAVELLE</b>								
Aluminum	36.50	18.57	7.95	63.02	360.50	507.80	487.30	8,541
<b>CONWAY 8L 44</b>								
Aluminum	30.00	76.20	20.48	126.68	384.20	193.40	607.83	5,546
Steel	157.91	47.41	14.34	219.66	554.16	307.40	861.70	7,841
<b>CONWAY 8L 44</b>	60.36	47.33	10.56	118.25	460.60	187.80	548.36	
<b>CONWAY 8L 44</b>								
Aluminum	17.35	10.33	6.41	34.10	193.34	69.48	344.58	15,346
<b>LOCKBARD 1000A</b>								
Aluminum	47.70	17.70	10.54	75.94	361.20	194.72	376.19	18,885
Brakes	43.99	125.63	19.37	189.01	369.33	93.72	665.93	16,145
Horizontal	55.45	55.45	11.34	122.24	354.88	111.23	471.35	8,819
Per Alloy	30.00	40.88	18.37	118.25	201.56	140.94	409.09	20,139
Horizontal	20.97	54.86	14.34	90.17	313.67	104.25	414.92	12,619
Wires	32.94	70.50	10.21	113.64	288.44	170.37	479.47	25,448
<b>PER BARBER</b>	36.50	18.57	7.95	63.02	361.50	344.79	546.86	
<b>STERLING 11000TD</b>								
Aluminum	29.45	21.80	7.90	69.15	193.26	41.83	227.92	25,357
Steel	50.40	34.94	11.16	87.48	184.34	29.45	243.97	20,837
Vertical/Cable	54.32	15.70	8.47	48.79	182.70	87.91	322.61	186,434
<b>PER BARBER Average</b>	37.75	30.36	7.92	56.13	144.91	40.40	206.48	
<b>ISLAND CONWAY</b>								
Aluminum	35.71	35.35	3.20	74.26	301.80	45.79	326.85	8,546
<b>SHINGO 137</b>								
Aluminum	23.98	35.25	7.45	66.68	104.76	31.23	202.71	11,120
Brakes	32.97	12.44	6.78	52.19	149.93	95.27	176.40	21,870
Non-Discontinued				81.88	213.23	36.97	358.23	4,347
Cables				17.91	157.64	27.78	203.33	7,819
Power	23.76	16.72	12.98	53.46	140.78	57.86	377.00	10,190
Permitted	34.23	18.45	8.34	61.02	127.24	32.43	188.47	16,661
Woven	39.43	17.42	7.26	64.17	207.18	14.53	175.45	17,445
<b>PER BARBER</b>				41.77	207.18	44.36	251.34	9,467
<b>PER BARBER</b>					89.85	342.45	43.75	187.84
1 Year Before Jan. 1st, 1947								



**BRISTOL T.155** test bed checks out operation of an auxiliary propeller fitted to side of fuselage. Main engine is enclosed in nose under the tip of the fin and operated by power control within the fin. Fuselage is reinforced and is pressurized. The slender steel structure

tailplane. All moving tailplane is hinged to the fuselage and engine nacelles are attached.

## T.188 Will Be Testbed for British Mach

By Herbert J. Coleman

**London**—Britain's newest flight research tool, the Mach 3 stainless steel Bristol T.188, will take a leading role in investigating a new generation of supersonic jet engines and high heat regimes leading to an Anglo-French Mach 2.2 rail transport.

Allied airframe has been specially designed to take a variety of phenomena and sophisticated skin and environment for both civil and military tests in the supersonic parameters. The T.188 began its flight test program this month (AW Aug. 25, p. 29).

The T.188, named *hazelle* (extra sensitive) because of its close over built in Great Britain, also is the first to have a sophisticated ground control and data recording unit developed in London. Ground control is at Filton, where T.188 test flights will be made.

At the end, European airplane designed specifically to explore high heat regimes; landing and taking off under its own power, the T.188 has a history of complex design problems because of its stainless steel construction (AW June 17, 1961, p. 95).

The airplane which has just flown is one of three built under Ministry of Aviation contract. Second T.188 is in advanced stages of construction at Filton and the third is at Royal Aircraft Establishment, Farnborough, for static testing under conditions of extreme heat, will over 3000°.

The T.188 is only part of an overall research effort by British designers to explore varied stages of supersonic flight. The *Hazelle*, page HF 111 will be used for "dry" data on studies at the low speed end of the spectrum (AW cover, Sept. 15, 1963).

Most airplane will be a modified

Finney FD.2 delta which set the world's speed record at 1,117 mph in 1956. Airplane is being fitted with an ogival (5-shape) wing as Bristol wing, is similar to that transmitted for the Mach 2.2 Super Gannet jet transport.

Under the Ministry of Aviation specification, the Bristol T.188 followed these design requirements:

- Capability of sustaining supersonic speeds well in excess of 1,500 mph for periods long enough to establish steady conditions for study of structural heating, cooling effects and aerodynamic phenomena at Mach 3.

- Tailored under its own power (two if Harland Gannet is expected), climb to operating height, fly a research pattern and return to base.

- Provisions for the use of the T.188 in progressive research on propeller development.

- Means for collection of data in greater

## 2.2 Transport

volume and detail than previously.

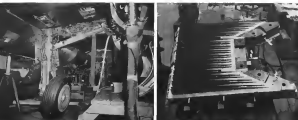
One of the most involved areas was refractive instrumentation, including type recording apparatus. Most has been manufactured and specially designed for the T.188 and all work had to be protected against the high kinetic heating that will encounter.

Dr. W. J. Stone, Bristol's chief experimentalist, said that the T.188 will be under continuous control from the ground, through constant VHF radio contact. The airplane has no navigation aids other than radio, since even a constant magnetic compass would be affected by the airframe; thus the pilot will be directed by another pilot in Ground Control, following radio positioning on a map transparency.

Aircraft itself will carry several heat flow, temperature, two independent electronic systems of Royal Aircraft Establishment design, manufactured by



**TWO DE HAVILLAND GYRON JR. DG** BD powerplants are needed for test runs at the T.188 engine test site at Filton. Balgus on top of nacelles contain one that for extrapropellers.



**CLOSUP** of engine of the T.188 looking from nose and wing. Note: Note designed by Goodson. Section of T.188 leading edge (right) is example of shallow construction. Note close-pitched corrugated skin. Struts used are made of steel, in both strength and stiffness.



**EASY CONFIGURATION** of the Bristol T.188 wing, nacelles and nacelles was flight tested on a modified rocket at British Army Weapons Proving Range at Aldermaston. Model was instrumented and data was transmitted to ground monitoring station.



Enos, the first thing chimp, don't tell the Gator must about his flight. Signals of data need over Vitro's early equipment did. Instead of the long standard for present possibilities, poor Enos was shocked.

to hear what shocked Enos...



That's the initial use of the complexity of the Vitro missile system. Vitro in the US Navy's systems engineer and coordinator, who has the interest of the many companies involved in Vitro. This system with potential, is designed.

to keep 18,400 switches open...



Over time of Jackass Flats, Nevada, this was the last site for the United States Nuclear powered missile vehicles. Right now Vitro is designed and engineering a major component of this system, installation.

to further complicate life at Jackass Flats...

**Vitro**

Vitro means imaginative application of scientific knowledge in electronics, chemistry, advanced R&D and engineering. Find out today how Vitro's creative ingenuity can help solve your problems.

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Beardcut an, provided in the airplane. On a 100,000 ft. pressure in the ground data and the second is used during flight. Signals from both systems receiving and all VHP radar connection will be recorded on magnetic tape, in the Ground Control Center.

Dr. Strong and selected data on system functioning and other engineering phases also will be transferred to the control room where it will be processed and multiplexed. Control includes a duplicate set of aircraft instrument data at the control console for constant monitoring of pilot information quantities. These include speed, Mach number, altitude, engine speed, fuel consumption and jet pipe temperature.

Wide range of engineering data will be presented in new features on the main multi-channel pen recorder, traces will give an immediate reference with an accuracy of plus or minus 1/10. Separate time-of-flight strip chart recorder will give a more accurate presentation of selected portions of the record.

Special provisions have been made for recording and monitoring factor quantities, with further data automatically plotted and presented in Nopart diagrams. Trained observers monitoring

these plots will be able to warn the pilot of a dangerous trend. Dr. Strong and Alton the flight test, the type recordings are used for quantitative quantities, such as system pressure and temperature, sampled at the rate of 2 samples per second and presented on speed, both pen consoles, one track produces 40 pen traces simultaneously on the three multi-channel recorder.

Aboard the T-188, the test pilot will have direct control of 12 penographic trace recordings, all of which are 50 mm. Also, Recorders give a frequency response of up to 50 cps and can produce a higher response, if required, for data on pressure, temperature, structural vibration and landing data. Film will be available in the test pilot's cockpit. OSCAR semi-automatic trace reading equipment which presents this information either in trace format, punched cards for further computing, or typed columns of figures and X-Y plots.

Despite its obvious value in development of a Mach 2.2 transport, the T-188, it is stated by Ministry of Aviation, is not and never was intended to be used in the test program of the Air Force. Peter Thompson, chief of the Air Force's Air Force, said: "We will have concerns in military research and he will not be flying in an 'isobaric' environment."

These developments in the test pilot's cockpit, the T-188, because of its stainless steel construction, will far exceed the proposed supersonic transport speeds and that will be able to receive new techniques and installations beyond its normal operational limits. This is an essential certification requirement, and the T-188 is the only airplane available in Europe for this purpose.

Guthrie L. Amy, Bristol chief test pilot, stated that another important item will be the composite one with which the T-188 can be refitted with other powerplants. The airplane design called for possible use in the airport test bed (ATB) Dec. 21, 1959, p. 22) and aircraft design and installation has been with this in mind.

Method of installation, Amy pointed out, calls for the specific, replaceable facilities to facilitate changes in air intake, engine or engine mount, and engine, of course, would have called for considerable reworking of the fuselage for new powerplants.

Use of separate nacelles also makes possible a substantial reduction of drag in supersonic speeds by reducing the air flow shock wave interaction between the fuselage and nacelles. Present engines, the de Havilland Ghost Jr. DGJ 10,

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to ignite to detonate to actuate to eject to open to close to pull to push to stabilize



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include variable geometry, afterburning, convergent-divergent multi-point nozzles and low frontal area. Thrust, with afterburning, is about 15,000 lb.

The nacelle air entered on a wing which has a span of 35 ft 11 in. and an area of 156 sq ft. Wing is of constant chord between the fuselage and nacelle, but outboard of the nacelle, the sharp leading edge is swept back at an angle of 58 deg. Tip of the wing, formed by the balance area of the intake forward of its hinge, has a leading edge sweep back of 64 deg.

Fuselage and nacelle feature area rule. Dr. Strang explained, in a press conference, that the aircraft is a Mach 1.4 although he added that the working jet will not be expected to give any significant benefit at the Mach 1.5 top speed. It is assuming the T-155 and also to generate load distribution, an extensive laser analysis was made of the pressure field over the entire airplane.

Since the nacelle has controlled inlet vents in the aftward direction, considerable effort was expended on their control systems. Dr. Strang and fuel solution was a shock wave control using, as a signal, the compression he twice the case surface pressure and the pressure in several points in the plane of the intake lip. The wind tests show the intake is capable of maintaining critical flow conditions during some changes of engine mass flow.

Special laboratory rigs have been designed for development and checkout of the T-155's engine system, including a fuel test installation, a correct geometrical layout of nozzles and components and corrective piping. Components are actually being fabricated as an engine and pressure have been used for pressure testing. The rig can simulate flight attitudes in push up to 180 deg., as complete overturn of the test rig. Dr. Strang explained that attitude in roll will have to significant effect on the engine performance since the fuel system is contained within the fuselage and is dependent under the entire line of the aircraft.

Hydraulic system has been proven on test rig which includes a complete landing gear layout and upward, rig for flaps, speed brakes and powered flying control units. Downward output unit built for complete integration of the hydraulic system and controls have been tested with a flight simulator to demonstrate pilot with control fuel.

Electrical system rig is partly integrated with the hydraulic rig.

Temperature control unit using the fuel as a heat sink.

An Dr. Strang pointed out, the T-155 can be compared with the North American X-15, aside from the fact that the X-15 is a rocket-powered and launched from a mother ship.

## PRODUCTION BRIEFING

British Ministry of Aviation has ordered 40 Folland Gnat advanced jet trainers to replace the Vampire T-11 now used by Royal Air Force. Final order for the Gnat, which was a British Siddeley Deputat 101 powerplant, is 107 planes.

Kathleen Co. has received a \$5.6 million Navy BuWeps contract for additional production of AN-505-51 fire control radars for Thor missiles.

Babco Watch Co.'s Research and Development Laboratories Division has received approximately \$1 million in research from the Boeing Co. to develop a safety control switch for the Minuteman ECM. The switch would sense the fuel safety "hold" or engine ignition devices on all three Minuteman stages prior to launch.

Leet, Inc., Grand Rapids, Mich., has received a \$2,132,112 USAF contract for production of prototype assemblies for F-105 and F-105B, B aircraft.

Otto Elevator Co., Brooklyn, N. Y., will produce electrical equipment, spare and related material for Boeing B-52 jet bomber under a \$2,219,979 USAF contract.

General Dynamics/Fairchild has received a \$1.77 million Navy BuWeps contract for further development work on the Ternor and Thor missiles.

Thokol Chemical Corp.'s Research Materials Division has received an \$8 million Navy BuWeps follow-on contract to produce packaged liquid propellant engines for Reddy air-to-surface missiles.

Goodrich Tex & Barber Co. has developed and tested a cell structure an aircraft tire which incorporates a rubber reinforced unperforated web band of steel wire. The tire also has Goodrich red nylon safety inserts to reduce wear when the tire is worn to minimum safety limits and must be replaced.

Center of Naval Analysis will be established and operated by the Franklin Institute in Philadelphia, under a \$2.5 million Navy contract. The center will conduct operational analysis studies and select a vehicle to be used in the Massachusetts Institute of Technology and the University of Delaware. Analysis both ground and launched from the center.

## THERE'S MORE TO

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**ASSIGNMENT**  
**THAN**  
**AIR CONDITIONING**  
**A HOLE**  
**IN THE**  
**GROUND**

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## Microwaves Offer Radiation Protection

By George Alexander

Atlantic City, N. J.—Space pilots may be exposed to controlled amounts of microwave energy during earth-based training to increase their resistance to solar radiation effects and some mechanical and physiological aspects to assure certain physiological functions in a zero-gravity environment, the recent meeting of the Aerospace Medical Assn was told here.

Disseminating experiments performed so far by the University of Rochester's (N. Y.) School of Medicine and Dentistry for USAF, Dr. Sel M. Mikhelson said that preliminary results showed some relationship between microwave exposure and protection in recovery of a body from ionizing radiation.

Of 34 dogs exposed only to 340 mrograms of X-ray radiation, 23—or about 67%—died within an average of 15 days. Before being subjected to this X-ray power, six different dogs were exposed to 2,560 msec pulsed microwave

radiation at a level of 180 mrograms per cm. Exposure times for the microwave treatment ranged from 3.6 minutes over head and the face between microwaves and X-ray exposure ran from 5.5 to 10 min.

When then exposed to 340 mrograms of X-ray, only one of three in control group died before the specified 16-day survival period. Four other dogs received the same microwave treatment but for shorter times of 16-50 min and with shorter dosed periods of 1-1.5 months between exposure to the two different types of radiation. This latter group experienced a survival rate of 77%, again suggesting that of untreated animals, and the result suggested that:

- Length of exposure is at least equal to exposure to power level
- Time lapse between microwave treatment and X-ray exposure has a significant effect in an organism's capability to withstand the larger type of radiation, but more exposure time to determine optimum time

Experiments were varied. Microwaves and X-rays were directed against some animals on a whole-body basis; others received both radiations only on their lower bodies or heads. Control dogs, for purposes of comparison, received only X-rays on their whole bodies, lower quarters and heads. Microwave levels also varied, with some dogs receiving 100 mro/cm<sup>2</sup>, some receiving 165 mro/cm<sup>2</sup> and some receiving both levels simultaneously. Length of exposure also varied and some dogs received microwaves after first being exposed to X-rays. Others were treated to microwaves and X-rays at the same time.

Microwave treatment more than four times after X-ray exposure did not seem to prevent or lessen injury to the animals, but in all other instances when the dogs received microwave treatment consecutively with X-rays, there appeared to be less damage.

### Several Possibilities

Mikhelson was cautious in setting an answer to the microwaves and suggested several possibilities, all of which would require further research, he explained.

- Increased stimulation by microwaves of cell activity in bone marrow—area very susceptible to damage by ionizing radiation
- Lower body temperature, apparently caused by adaptation of the organism to constant microwave exposure. During exposure, animal body temperature rose but continued application of microwave energy was observed to result in a constant temperature drop of 1 or 2° in the dogs.
- Altered molecular response of an organism caused by microwaves which perhaps then inhibited further electronic excitations and nuclear fission of two radicals by ionizing radiation.

USAF Capt. Duane L. Glavinne, Aerospace Medical Laboratory, Wright-Patterson AFB, Ohio, told the meeting that the absence of several cardiovascular stimuli in a prolonged space environment could result in peripheral blood pooling and a lowering of venous pressure. While this would not be overly serious during flight as space Dr. Glavinne said, it could lessen the regulatory system's adaptability to meet new situations—such as sudden transition from zero orbital flight to the rapidly increasing and high positive g-forces of reentry.

The effect of reentry on a pilot whose circulatory system had experi-

enced a decline in adaptability while under prolonged stress could be compensable in a man trying to use and perform strenuous activities after actual would confinement to bed. Training is not suitable in either situation, Dr. Glavinne said, and should occur during the reentry of a spacecraft, it could have fatal consequences.

The USAF medical office described some recent experiments conducted in a water tank at Wright-Patterson and one technique that had been studied to optimize the human body's adaptation circulation system prior to leaving the tank after long periods of non-movement.

The technique involved a series of transmitters wrapped around the subject's thighs and upper arms. Artificially, the transmitters were electrically triggered over other transmitters to a pulse of 60 msec of current to obstruct the venous blood flow and cause a pressure rise. Non-invasive cardiovascular problems were maintained by subjects equipped with the transmitters, while unprotected areas in the tanks generally became incapacitated after 24 hr of exposure. Dr. Glavinne also said that the use of drugs should be investigated to find one that would have the same result as the transmitters with no or at least non-toxic side-effects.

Dr. Cdr. Norman R. Goudie, Naval Air Station at Norfolk, Va., pointed a report on the possible interference caused by prolonged stress on genetic activities. The Navy commander said that food-of the capsule could result, as well as the genetic material, in a study by Lt. Col. John Glenn and Maj. Glennan Tilton—men from the upper half of the standards to the lower half under the force of gravity. It is generally agreed he said, that possible or ripple-like contractions of the stomach, began at about mid-stomach and lower food by muscular contractions down to the pylorus, or opening from the stomach into the large intestine.

In the absence of positive gravity, Cdr. Goudie said, it is possible that food might be in the upper stomach where the mesh of peristaltic action and thereby cause some indigestion and nausea as well as producing the space pilot from deriving any benefit from the swallowed food. Cdr. Goudie suggested that it might be necessary to provide personnel operating in space for long periods with a drug that would stimulate peristalsis.

A USAF School of Aeronautics Medicine report on the unbalanced stresses of g-forces and radiation was presented by the coordinator, Dr. M. J. Zeller. Dr. Zeller said Dr. Zeller and his group had set out to determine if high g-forces would lessen an organism's resistance to harmful radiation, thus found instead that resistance was increased.



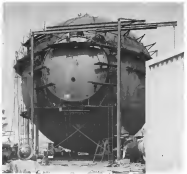
French Developing Photon Satellite

France's SEER (Société d'Etude de la Propulsion par Reaction), owned by French aircraft and chemical companies, is developing the Photon satellite, designed to be launched into a low orbit and then progressively move under its own power, into a 24-hr orbit, performing scientific experiments as the way. The 6-ft. dia. satellite will be equipped with a probeable sensor which will focus the sun's rays on a memory board system (optical storage in photo of the model), used to generate electricity without to cyclic instrumentation.



The USAF group used two groups of rats, one as a control group for which the lethal dosage of cobalt 60 was established and the second as the experiment animals. The experimental rats were irradiated in a small specially built container and accumulated up to 11g. G-forces were positive, negative and transverse and down of the cobalt 60 were gradual, with exposure in the abdomen increasing before, during and

after use in the usual arrangement. Dr. Zeller said that the USAF group found that as g-forces increased, so did the radiation level required for lethality. The USAF physicians and these new indications that g-forces may protect organisms as severe as jet ride seemed to agree against previous effects. Radiation—particularly of the eyes on causing eye-to-accident much often as in the head-venter. USAF Maj.



Hypersonic Wind Tunnel Near Completion

Vacuum system, with 150,000 cu ft. capacity, will provide wind for hypersonic tests designed to test vehicles from 1.5 to 14 times that of sound. Tunnel, being built by Northrop's Puente Division, will simulate altitudes to 275,000 ft., temperatures to 3,500°



## Automatic temperature control GSE for Titan II missile propellant

This new environment control package was designed and produced by Hamilton Standard for the Martin Marietta Corporation's Titan II missile. It automatically stabilizes propellant temperature at  $69 \pm 5^\circ\text{F}$  within a 30,000 gallon storage vessel. The unit electrically heats or anematically cools a glycol and water heat transfer liquid, and then circulates it to the storage vessel heat exchanger. It is built to perform reliably in ambient air of  $-35^\circ$  to  $+115^\circ\text{F}$ , and from sea level to 6,000 feet.

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environment control GSE assignments. It typifies the results attainable when engineering capabilities in pneumatics, hydraulics, electronics, and packaging, are combined with specialized manufacturing skills.

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defined by Cockfield, Accelerated Field Laboratory, described a radiation monitoring system being developed for Air Force by Philips Corp's Western Electric-Laboratory that will differentiate various radiation bands and intelligent particles in space, their relative velocities, the dose rate of each band and the overall dose rate of all bands and particles. Weighing a total of 62 lb, the system is scheduled to be before tested this summer and placed in a 300-mu. high orbit west coast by a Blue Scout launch vehicle or as a piggy back satellite should some other launcher.

Capt. F. W. Chambers, Jr., U. S. Naval Medical Research Institute, discussed the use of ionization chambers and mass-equivalent gases to measure radiation absorption and Dr. Michael Lee, University of Rochester, with USAF Maj. Lawrence T. O'Hall presented a report on the prediction of human response to ionizing radiation by measurement of the metabolic rate as indicated by temperature drops or increases that space flights could be expected when dosage levels began to approach the danger point.

Robert J. Horvack and Robert W. Coates, Southern Research Laboratories, held the session that studies of vibration effects on human performance had essentially confirmed the earlier finding of H. E. von Gorker that the frequency range of 3.5 to 20 cps was particularly critical for seated subjects.

The two scientists stated that low frequency vibrations induced in human subjects longer reaction times in the making of decisions, decreased tracking

ability in the making of dark displays and controls, loss of visual acuity, decreased speech intelligibility and diminished respiratory rate but increased oxygen consumption. They noted that with the development of "hot" launch vehicles, which "are more likely to be ejected at lower frequencies" spacecraft would have to be designed so that vibration levels will fall below critical levels and that resonance frequencies would be attenuated. Design of a spaceworthy display and equipment also would have to make allowance for the stresses induced in a crew during vibration.

Concurrent work on vibration in the 0.17 cps range by the Boeing Co. was reported by F. W. Seiler of the company's Wichita, Kan., division. Test rig simulated a cockpit, with an engine, propeller, seat, control columns, throttle pedals and supplied power all mounted on a vibration table. Amplitudes of 20 in. peak-to-peak, and accelerations of up to 1g could be achieved on the simulator.

Seiler said that some showed that test subjects would accept higher frequencies at higher g-forces, man reported 15 cps. in "shaking" the highest vibration level at slightly less than 1g, or they also called 5 cps at about 1g. Seiler said that vibration damaged some performance tasks but not others—such as high concentrations and that vibration was perfect in the 12-25 cps. range. He added further research was needed to confirm indications that subjects are not always aware of performance degradation and that a correlation exists between certain frequencies and affected body regions—particularly the head.

To measure the effects of acceleration on pilot performance and physiology, Brian Y. Cass, Julia D. Stewart and Joseph G. Donnellan Jr., of the Naval Aerospace and Space Administration's Ames Research Center tested human subjects wearing the Ames-developed high cabin space suit (IAW July 3, p. 8) on the X-15's centrifuge at Edwards Air Force Base. Subjects responded to track a randomly drawn target displayed on a outside air tube within the centrifuge's gondola using a finger suspended to rotate radially, via a cable. Feedback presented on the tube, controlled re-entry onto the earth's atmosphere.

G-forces were applied along the y-axis (toward head, or earth's down) (EFG), other than low g-axis with shock (EBC) and back toward pilot, or earth's up (EBU). During the centrifuge runs, the Ames engineers concluded that pilots could function longer in EBU and EBC fields than under EFG forces. In fact, pilot performance dropped off sharply at 7 g EFG.

Tom also indicated that for the true g force, a pilot can perform his assigned

major longer times in an EBU—rather than EBC—position. Size and efficiency of breathing was greater in an EBC position, but otherwise of the eyes observed the pilot's vision in tracking the target to such an extent that the advantage was effectively negated. Centrifuge was spun up to a maximum of 14g with a tolerable time of less than 1 min. in an EBU position. Moments after that pilots could tolerate EBC up to 18 for less than 1 min. Moments EBC g force was between 7 and 8 for slightly more than 1 min. For 30-min runs, pilots could tolerate 6g EFG, 7g EBU and 5.7g EBC. Vision and tracking was best judged at 0.5g/sec, 0.33 g/sec, 0.75g/sec and 2g/sec.

There appeared to be no consistent difference in tracking errors during runs between EBU, EBC and EFG positions, but it was noted that the pilots' abilities to track declined rapidly above 0.75g/sec. The three Ames engineers pointed out that for a spacecraft with a life-drag ratio of 0.5, the maximum acceleration limit is very low. It may be about 0.5g/sec—within the trained pilot's ability to perform satisfactorily.

## Soft X-Ray Probe Tests Planned

First soft x-ray probe studies of soft X-ray emitting heat sources in deep space will be conducted this summer by National Aeronautics and Space Administration at Wallops Island, Va.

The experiments, planned by Lockheed Martin and Space General, will use new types of photon detectors now being tested in prototype form. They will be launched by Space General Aerobee rockets from existing pads at the NASA launch station. Soft X-rays have been known between 10 eV and 10,000 eV and lack the penetrating power of hard X-rays. They are completely absorbed long in the atmosphere and can be studied only by instrumentation aboard rocket vehicles. Soft X-rays are electromagnetic radiations with a wavelength slightly shorter than ultraviolet and their production similar effects.

Radiation present on the tube, controlled re-entry onto the earth's atmosphere. G-forces were applied along the y-axis (toward head, or earth's down) (EFG), other than low g-axis with shock (EBC) and back toward pilot, or earth's up (EBU). During the centrifuge runs, the Ames engineers concluded that pilots could function longer in EBU and EBC fields than under EFG forces. In fact, pilot performance dropped off sharply at 7 g EFG.

Tom also indicated that for the true g force, a pilot can perform his assigned



**Photo-multiplier Tube**

Photo-multiplier tube, which requires no glass envelope as radiations, are converted into an electron cascade. The tube develops its electron multipliers. P. W. Seiler, Jr., Ames Research Center, said that the tube, controlled re-entry onto the earth's atmosphere.



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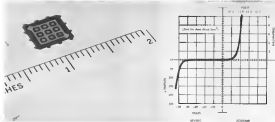
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**SILICON P-N JUNCTION DIODES**, produced by thin film deposition on a ceramic substrate without use of seed crystal by Sylva (left), opens the way to producing complex integrated micro-circuits with active elements in a single manufacturing operation. New thin film diodes exhibit square-law characteristics (right) of diodes made by conventional processes for general purpose use.

## Thin Film Diodes Achieved on Ceramic

By Philip J. Kiss

William, Mass.—Single-crystal P-N silicon diodes have been successfully fabricated by vapor deposition on a ceramic substrate using a new technique developed here in the Microelectronics Laboratory of Sylvania's Electronic Systems Division.

The subsidiary of General Telephone & Electronics Corp. now is applying the new technique to the problem of producing thin-film transistors on ceramic substrates. If successful, it would be a major breakthrough in the field of microelectronics.

Sylvania has deposited up to nine single-crystal silicon diodes with diameters up to 8 in. on ceramic wafers measuring  $\frac{1}{2}$  in. square. It has achieved yields of 100%—near good diodes out of one deposition.

Like other companies working to develop techniques for depositing active semiconductor devices on a foreign substrate (non-semiconducting, non-single-crystal), Sylvania has been obtaining rectification action from its thin film devices for nearly a year. But it is only within the last several weeks that the company has been able to produce devices with the characteristic "sharp knee" performance of diodes made by conventional techniques, according to Gerald J. Selva, manager of the Microelectronics Laboratory.

The diodes which Sylvania is producing by the new process have performance comparable to standard point-

contact-passivated junction diodes. With additional work, the company hopes to produce diodes with improved characteristics.

Sylvania is understandably selective about the new process. It will only say that the process involves an "epitaxial technique on a ceramic substrate with special surface treatment but with no single crystal seed on the base."

### Other Advances

The company funded micro-circuits program, which has been under way here for about three years (AW May 9, 1960, p. 107) recently has achieved other significant advances in the film technology. These are based on one of 20,000 volt-electron beams, now actually focused to a spot size of 0.06 in. in diameter, equivalent to a power density of 14 million watts per square inch. This is adequate to vaporize high temperature materials and sputter many materials. Vaporization takes place at a vacuum of around  $10^{-6}$  torr.

Sylvania is continuing its research in how thin film technology, but has just opened up a new pilot production semiconductor facility here at William.

As new techniques reach the required state of reproducibility, they will be introduced into the pilot production line. Most of the more advanced techniques described below are scheduled for generalized introduction to the pilot production facility during the next six to eight months.

One example is a newly devised tech-

nique for coating the surface of ceramic wafers with an extremely thin layer of high temperature glass which is less than one-thousandth (0.0005 in.) thick. This provides a substrate for deposition of thin film components which can handle high strength, heat resistance and thermal conductivity of ceramic, with the extremely smooth surface characteristics of glass.

Such glass coated substrates can operate at temperatures up to 800°C. Some pins have been heated to 1500°C, then thermally shocked into -800°C temperature without fracture, warpage or separation of glass from ceramic substrate, Sylvania says.

The glass surface permits fabrication of conductors and insulators with narrower widths than is possible on untreated ceramic, increasing the amount of circuitry which can be produced on a single wafer. The new glass-coated ceramic is expected to go into use in the pilot production facility this fall.

Sylvania currently is using ceramic wafers which measure  $4 \times 3 \times 0.01$  in., but when receiving  $4 \times 3 \times 1 \times 1$  in. will be added to provide circuit flexibility.

### Higher Resistivities

Initially, the pilot production facilities will use ceramic for fabrication of thin-film resistors, which have a resistivity of about 100 to 350 ohm per square.

Late this year, the company expects to introduce modified carbon deposited



**NEW SYLVANIA PILOT PRODUCTION FACILITY** initially will use conventional techniques to produce deposited passive circuitry with separate micro-diodes and transistors. New, more advanced techniques developed in the laboratory will be introduced this year. Vacuum chamber in rear facility is controlled from console (left). Micro-circuitry (right) is deposited on ceramic wafers (1) which is uncoated (2). Interconnection bonds (3) with differential wiring deposited (not visible) nuclear group of ceramic whose submicroscopic surface hole left for bonds and are subjected to sintering on the board (4).

resistor, providing resistances up to 500 ohms per square, with a corresponding reduction in space required for resistors on the substrate as compared to maximum resistance obtainable. By moving metal particles with the carbon, it is possible to control the temperature coefficient and sensitivity of deposited carbon resistors.

In the laboratory, Sylvania is able to produce deposited carbon resistors to tolerances of 2% through use of (1) vacuum, but currently is achieving 80% tolerance in its first pilot production line output. With additional experience, the company hopes to drop the 10% figure, perhaps down to 2%. Selva is confident that 2% tolerance can be achieved in the pilot production facility where deposited carbon is introduced.

Another promising resistive material under investigation is a multiple coat of titanium, covering practically all titanium could be with small amounts of diodes, insulators and the metal itself. The other resistivities of about 10,000 ohms per square, as twice that obtainable from modified carbon.

### Higher Dielectrics

Titanium also is a promising material for capacitors. Titanium dioxide has a dielectric constant of about 180, compared with only 6 for water and 3.5 for glass, and 15 to 16 for barium oxide, Selva points out. By controlling the amount of oxygen injected during the deposition process, the same work-

ing material used for resistors can also be employed to produce dielectric films for capacitors, and the metal itself can serve as capacitor electrodes.

Sylvania has produced capacitors using titanium dioxide as the dielectric which exhibit a capacity of 9 mfd per square inch, with a breakdown voltage greater than 15 volts, Selva says.

Sylvania finds titanium dioxide over titanium oxide not only for its higher dielectric constant, but also because it does not have high electrical losses at higher frequencies, about approximately 1 line, in direct terminal circuit, according to Selva.

In the hope of achieving further reduction in the size of thin film capacitors, Sylvania is working on a new technique, according to Selva, General Telephone & Electronics Research Laboratories in Bristle, N.Y., are investigating human tissue, which has a dielectric constant that is nearly three times that of titanium dioxide and which appears adaptable to the electron beam evaporation process used for fabrication of other circuit elements.

For conductors, Sylvania has recently developed a technique of sputtering metallic metals which permit it to select a material with electrochemical and other transitive properties that are compatible with materials used for other thin film components with which the conductors are in contact. The present list includes copper, aluminum, barium, copper, gold and titanium.

In the laboratory, Sylvania has been able to introduce deposited conductors

with line widths as small as two mils (0.002 in.) and hopes to achieve three more standards in its pilot production line by this fall.

To reduce line widths, Sylvania is changing the pattern used to manufacture dimension masks. Instead of using etching, which usually results in under-etching that broadens the mask hole, company is switching over to building up the mask by an electroplating process.

### Packaging Method

The four square ceramic wafers to be used in initial pilot production have three small tabs protruding along each of the four sides. Conductive films are deposited on all four sides of the tabs in the exact regions to provide for external connections.

Once the ceramic has been fabricated, it is first coated with a flexible adhesive to provide a cushion around the circuit. Then it is encapsulated in an epoxy resin in a rectangular form factor.

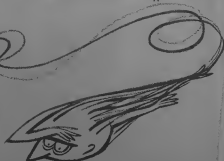
Current laboratory work with electron diodes suggests that it may prove superior for the radial contact protection function prior to epoxy encapsulation.

To package several small integrated circuits into a module, Sylvania uses low surface rectangular interconnection bonds, providing a standard pig board except that this holds an irregular pattern of circular. The interconnections between elements are screened and fixed on the surface of each board. The interconnection bonds are then placed



## This is a satellite seeking re-entry...

Satellite men are satellites. There is a predictable period to their travels through the rocket motor industry. Sometimes sunseeking, occasionally mildly eccentric, always independent, they find security in returning to the same old paths. They will not find entry at UTC. United Technology Corporation has an increasing number of positions open for scientists consciously seeking new paths. Important and challenging studies underway include multimegawatt, segmented, solid propellant boosters, hybrid engines, ablation-cooled thrust chambers, filament-wound fiberglass rocket motors. Scientific staff members are preeminent in American rocketry. UTC is solidly backed by the tremendous resources of its parent organization, United Aircraft Corporation. The company's assets include a 30-acre Research and Engineering Center, and a 5,000-acre Development Center. Satellite types won't rise to UTC's invitation. Those scientists who do will create America's rocket motors. An Equal Opportunity Employer.



## Opportunities for the unusual man UTC

**Dr. Design Engineer**—Supervision of a group in design of solid rocket motor components. Requires professional degree and a minimum of 5 years rocket design experience.

**Engineering Analyst**—Systems Design. To formulate mathematical model of systems engineering problems and implement solutions by analytical techniques. Requires degree with solid mathematical foundation and 2 years design or systems experience.

**Solid Rocket Project Engineer**—Full update in all phases of solid propellant rocket development with emphasis on design, processing, and testing of large solid rocket engines. Excellent growth potential. Requires degree in engineering degree plus 5 years experience in rocket engine development.

**Senior Engineering Specialist**—Original advanced design, analysis, and evaluation of liquid and hybrid rockets, systems, and components. Will organize and execute programs and projects. Requires engineering degree plus a minimum of 4 years creative and analytical work.

**Aerodynamic Specialist**—Will perform heat transfer that include wind tunnel aerodynamic studies on rocket motors, develop new methods of analysis and design tests. Will work with development and project engineers on major engine programs. Requires master's degree in mechanical or aeronautical engineering and 4 years experience in aerodynamic studies and heat transfer.

**Quality Control Engineer**—Monitor rocket center processes, hardware building equipment, propellant processing. Requires engineering degree plus 2 years experience.

**Propulsion Engineer**—For analytical studies of solid and liquid propulsion systems. Requires degree with advanced mathematics, thermodynamics and fluid mechanics background.

Positions also for process equations supervisors.

**United Technology Corporation**

Dept. 14-A Box 358 Sunnyvale, Calif.



## FILTER CENTER

**New Names for E-System-Soviet Air Force L-System**, formerly identified only by number, have been officially given new popular names. These are as follows:

- **4134** *Guideline* (Air Weapons Control System)
- **4134-1** *Meteor* (Weather Observing & Forecasting System)
- **4134-2** *Headshot* (Headquarters USAF Command & Control System)
- **4134-3** *System* (Air Force Communication System). This function has only been known as *Arctic*.

**Headshot Fuel Cell Program**—Army Signal Corps has issued requests for proposals for research program aimed at development of a fuel cell which can micro-processor and/or computer to generate electricity.

**Martin Developing Laser Radar-A** 15 lb portable laser radar for battlefield use, to measure range of targets such as tanks and airplanes, is being developed by Martin Company's Orlando Division. Company says the laser radar could be ready for mass production within a year.

**Remotely Controlled Micro-Mission Launcher**—Efficient among engineers conducting experiments are being given to carry small balloons to enable them to read sides whose diameter are too small to be comprehended with the naked eye. At least a dozen pairs of space glasses were in evidence at the recent Institute of Radio Engineers convention in New York. One engineer sitting in the front row, less than 10 ft from the screen, was seen using his space glasses, giving some indication of the size of the slide material.

**Naval Fleet Activities Maintenance Study**—Naval Training Center, Port Hueneme, Calif., is conducting comprehensive study of conducting comprehensive program to evaluate various trouble-shooting techniques for electronic equipment. Program will include recommending training capabilities to maintain and personnel to the most efficient trouble-shooting techniques. Other operating research and development programs include:

- **Optical indicator** with high information rate capabilities, suitable for use both with coherent and quasi-coherent light sources and capable of transmitting at least 25% of the light emitted by the source. Aeronautical Systems Division, Wright-Patterson AFB, Dayton, OH 45433.
- **Digital computer techniques** capable of simulating the dynamic response

characteristics of a jet engine and its control system. Aeronautical Systems Division, Wright-Patterson AFB, Dayton, OH 45433.

• **The above integrated circuits**, each capable of performing digital logic functions, are the other designed for continuous-wave laser applications, is to be fabricated on a single silicon chip using deposited thin film process technology. Army & Navy Supply Agency, Fort Monmouth, N. J. AFJG-63 ELPD-4001

**Japanese Research Bibliography Available**—First bibliography of Japanese research in surface and solid-state physics compiled by Commerce Department's Office of Technical Services, is now available. Report, entitled "Japanese Science and Technology," 50-477, can be obtained for \$1.00 from AFOS, Commerce Dept., Washington 25 DC.

**New Navy Use For Tacon**—Tacon navigation sets in Navy fighters will be modified to enable one aircraft to determine its distance from another, but several modifications, in addition to conventional role of determining aircraft bearing and distance from ship-based or ground-based Tacon stations. Modifications which will give Navy Tacon sets the added capability will be provided by General Dynamics Electronics under a \$2.1 million contract. Principal element in the modification kit is a completely restructured modulator which will be substituted for the present vacuum tube unit.

**USAF Reports Gravity Wave Studies**—Recent interest in the study of gravitational waves is evidenced by recent article which outlines the results of gravitational waves, or gravity waves, the propagation of light in a constant magnetic field or electric field. The Soviet article says that calculations based on tensor analysis indicates that for interstellar fields, the ratio between the squared gravitational and light amplitudes is  $10^{-10}$ ; if the light is based time in a constant field is 10 years. The article says that the general relativity theory also postulates the possibility of transducing gravitational waves into light waves, but that this process is "farther of interest." The article by M. Ye. Gutsenko is appeared in *Elektromagnitnye i Tsveticheskaya Fizika*, Vol. 41, 1967, p. 111114.

**Portable Autopilot To Fly Japanese Helicopter**—Edgemoor division of Bendix will supply a modified PB-20 autopilot (PB-20) to Nihon Acroprene Manufacturing Co., Ltd., Tokyo, for use on company's YS-11 helicopter. The PB-20 is reported to weigh less than 50 lb.



**REINFORCED MODEL 65** QUEEN AIR aircraft were down assembly line along with earlier Model 65 versions. Production of eight Model 65s per month is scheduled for later this year. Current backlog for the new Queen Air version according to Beech, exceeds \$5.5 million. Assembly is kept busy in Teterboro, New Jersey, Beech's distribution hub.

## Queen Air Power, Performance Increased

By David H. Hoffman

Teterboro, N. J.—Beechcraft Model 65 Queen Air—remains the Model 65's 44 more powerful engines and a swept-in-thrust engine nacelle engine nacelle and propeller entering speed while retaining all the responsiveness of the Model 65.

For example, single engine rate of climb at maximum continuous power is the same—1,000 ft/min. The composite figure for the Model 65 is 175 ft/min, as greater by about 50%. At takeoff power, single engine climb rate for the Model 65 and Model 65 is 245 and 335 ft/min, respectively.

### Cruising Speed

Speed/rate has increased in the Model 65's higher cruising speed, which, at maximum gross weight, is about 12 mph greater than that of the Model 65.

During a 2 1/2 and 36 min flight with Martin Scott, manager of Queen Air sales for Beechcraft, Pro Aviation West, pilot concluded that the Model 65 exists in cockpit and cabin comfort.

The rugged twin possesses all the qualities noted by Aviation Week in its original evaluation of the Model 65 (AW Oct. 26, 1979 p. 144). And, for an \$1,000 increase, it also appears easy to extract from a jet's harsh, dangerous situation.

### Small Experiment

At 5,180 ft, for example, we applied 65% power, which the engine rate a 35 deg bank and pulled in nose up sharply to induce a stall. As expected, falling all rapidly, reached 85 mph when the stall warning horn sounded. The full stall followed at about 70, marked by a deep boom, in which the aircraft itself to roll itself out of the turn.

As we started a recovery, Scott nudged the bars of the control side all the way back and pulled the Beech's back a further half. Holding the roll, he made several turns to prove that the Model 65's always return their effectiveness down into the stall region.

Rate of climb indicator was again up a 700 ft/min decrease when Scott retracted back pressure on the yoke.

The Model 65 gracefully flew itself out of the stall without further engine action.

Base price of the Model 65 is \$115,000. Moving up the scale, the Queen Air Commander, at about \$1 million, is the next new aircraft designed per month for executive flying. It is then price increases between the Model 65 and the Commander, that manufacturers have to fit with light, twin-engine aircraft such as the Jet Commander, the SAAC 21 and the Pegasus 330.

### Competitive Aircraft

On the low end, the Model 65 will be pitted against Aero Commander's Model 680P, which has a base selling price of about \$120,000. Conversely, the Model 65 is competitive with Beechcraft's own Super 33, at about \$132,000, and with the Model 67 at \$136,000.

Because of this intra-company competition to sell their aircraft levels per month naturally the same, it is considered probable that Beech will include the Model 65 from its product line in the not too distant future. This cost, however, the company will continue to

write the Model 65 available on 120-day terms. Its success for doing so probably spring from a large parts inventory, a backlog of international customers and the fact that since mid-1978 the 59,000 price differential between the Model 65 and 65 decrease.

According to Beech, peak production schedule this year will reach in the order of eight Model 65s per month. As of last month, the total actual value of Model 65 orders exceeded \$5.5 million.

The aircraft flown by Aviation Week (N633) was equipped with \$79,750 worth of optional features. However, that could have influenced the evaluation. The aircraft was also light, weighing just more than 7,000 lb at the time of first takeoff, and therefore was probably more responsive than a fully loaded Queen Air.

### Roomy Cabin

Entering the aircraft, we noticed first the spaciousness of the Model 65 cabin, with its 57 in. of head room, and the presence of a lavatory. Neither feature represents a change, but both set the aircraft off from standard piston twins that can crisscross someone as long as the Model 65.

Along each side of the Queen Air's cabin are three large windows. In a right turn, the pilot in the left seat has excellent aft visibility. Smaller windows on a cramped cabin would force him to rely on a copilot.

On takeoff, because of the engine's fuel injection system, a pilot should not have the application of full rated power. But we noted no lag between throttle movement and engine response during our brief roll down Teterboro's north runway. Nose wheel steering, controlled by foot pedal pressure, could be sluggish at 50-60 ft, when the sudden become effective. Steering is not a basic sensitive system on the Queen Air, and we found that even the heavy-footed pilot need not worry about cross-controlling the aircraft's attitude while waiting for maximum speed.

During three instrument landing system approaches at MacArthur Field, Hines, Long Island, we judged the aircraft extremely stable. It seemed to react very little more than the glide path or localizer and could be flown almost hands off down to minimums. If a little power is retained during round out, it can be used to enhance a decent landing from a high turn. The Queen Air tends to settle gradually as the landing configuration is throttled as returned to the idle thrust position.

At 1,600 ft, we lowered the right engine and the Queen Air moved greatly into its optimum position. Having the back to the approach heading, and we began rolling in time to get hands-



**MANUAL MIXTURE CONTROL** allows for precise mixture adjustment as an RPM rise of Model 65 pointed with fuel flow meter beneath vertical speed indicator at left. Radio is RCA AV-15, optional for \$1,400, installed.



**LYCOMING 6500 340-AT4** engine develops 102 hp at 2,600 rpm. Stroke has been increased 6.5 in over B1A engine on Model 65, ensuring weight about 10 lb per engine.



**SWEEP FIN**, which provides Model 65 Queen Air with its distinctive look, also gives pilots area and helps one to provide effective control with main power engines.

all stability. With 1.5 deg. of roller trim, control pressure as long as needed to compensate for the forward engine.

We then discovered that along with the dual engines in the Model 80 are a powerless engine. The aircraft must remain stable, though, as it would be expected, but there is no tendency to roll aftward in control.

Adversariously, it is probable that had Beech brought the two Model 80 engines in closer to the fuselage, the aircraft would offer even greater stability around its vertical axis. But would levels of the other model climb perceptible at a mile?

At 5,000 ft., with 80% power, 30 deg. descent an unimpaired and one engine feathered, the Model 80 achieved 191 mph at 100,000 continuous power and 125 mph, we achieved a 790 ft/min climb rate on one engine.

Powering the Model 80 are two 180

hp Lycoming JC50-540-A1A engines, which replace the two 160 hp JC50-160 A1A engines installed on the Model 65. Although the Model 80's additional power should imply a substantial reduction in fuel consumption, such is not the case.

By apportioning the reference fuel metering system on the Model 65 engine with a manual reference control, Beech accurately can claim that the Model 80 burns less gas per hour at lower power settings. Consumption also can be monitored, for the Model 80 is equipped with fuel flow indicators so that a pilot can perceive precise consumption on long cross-country flights.

To build Model 80's maximum control speed at 95 mph despite the additional thrust, Beech enlarged the size of its vertical stabilizer from 27.82 to 31.4 sq ft and used wing lock to give a longer run. Both changes were necessary in order to cope with towing loads

imposed during single engine flight. Beech also was able to hold Model 80 at speeds at levels comparable to those of the lighter Model 65. To do so, it removed the gap between the trailing edge of the wing's wing and the leading edge of its flap. Air flow across the upper surface of the wing that became more efficient, compensating for the Model 80's extra weight.

## PRIVATE LINES

Beech's plan to take over the de Havilland plant at Chittenden where de Havilland plants it out in long have been dropped [AWM May 12, p. 26]. The executive reaction from instead will expand private facilities at Shoshone Park, Minnedota, director, and the reason for dropping negotiation on the Ministry of Aviation noted plant is that the plant area associated too much bureaucracy and politics could not be added successfully.

Sales for the first half of General Aviation Co. Inc. 1962 totaled \$49,220,000 as compared to \$5,647,000 over the same period last year, an average increase of \$5,316,000 or 95 cents per share compared to \$5,228,000 in 99 cents a share for the first six months of Fiscal 1961. Business aircraft sales totaled \$29,282,000, a 68% increase over the same period last year. The company cited its regular customers, each divided of 25 cents per share payable May 16 to holders of record May 1.

Lockheed jet executive aircraft completed a 15,000 mi. trip to Hong Kong from Monterey, Cal. in 10 hr. flying time, the company has noted. The jet flew by way of Canada, Arizona, London, Rome, St. Martin, Tokyo, Taipei, Seoul, Tokyo, New Delhi, Bangkok, and Hong Kong. Documentation flights brought the total flight time to 45 hr. 17 min. Lockheed and the aircraft is named as maintenance during the trip.

Production model Cessna 210 equipped with auxiliary fuel tanks flew non stop from New York to Dallas, Tex., 6,170 mi., earlier this month. Aircraft was scheduled to land at Denver, Colo., but continued on to Durango where weather closed the Denver Area airport. Aircraft was being delivered to Stu A. Cessna, Cessna distributor in Argentina.

Sperry unit for the Hughes 299A helicopter has been developed by Agnietron Aviation Engineering Co., Santa Clara, Calif. by Hughes Aircraft Unit, which weighs 70 lb., has a 40-gal. capacity and a 25-ft. boom. Sperry pump is belt-driven from the helicopter's engine.

## EQUIPMENT

# Control Modules Reduce Pershing Weight

Modular approach to refinement of the hydraulic control system for the Army's Pershing ballistic missile support module (AWM Apr. 8, p. 86) has trimmed the weight of that component by about 35%.

General Precision, Inc.'s Kierulff Division at Little Falls, N.J., put the modular system into production last year after achieving 100% reliability work at its Pershing flight test data base to April, 1961. Kierulff secured a \$2.5-million production contract for the system last November from Martin Co., Pershing prime contractor.

The new system, which Kierulff engineers say is applicable to any missile, also told hydraulic control system weight from approximately 100 lb. to 150 lb. Individual module replacement in an undercarriage, three to eight stages, with each module weighing 25 lb.

These modules incorporate all necessary components for pistoning, actuator, and control of the module. Each module is a complete closed system, with the valve, actuator, motor, and control. A valve, motor, and control pump do double-duty, serving both as a valve, actuator, and control. A valve, actuator, and control pump do double-duty, serving both as a valve, actuator, and control. A valve, actuator, and control pump do double-duty, serving both as a valve, actuator, and control.

The module is filled with hydraulic fluid at the Kierulff factory. The accumulator is precharged, and the entire system is sealed prior to delivery and

attachment to the missile to reduce the hazard of contamination entering the system during its operational life span.

The original Pershing hydraulic system, similar to that on other missiles, consisted of a central hydraulic source with all plumbing and related equipment.

The new modular system is self-contained. The only required input is the power connection to the pump system and the signal connection from the missile guidance system to the servo valve.

Weight saving of 35% is realized even though there is a reduction in component, such as pumps, motor and actuators. Kierulff says.

A return valve, developed by Kierulff as the integral part of the modular hydraulic system, is composed of a direct current drive motor coupled to a piston pump spring loaded fluid motor, pressure regulating valve, high pressure accumulator, pressure relief valve, an electrohydraulic servo valve, linear hydraulic actuator cylinders, linkage components, two rotary valve drives, and a linear position feedback potentiometer with two outputs.

These components and additional pistoning and actuator devices are mounted on a cast aluminum block. All fluid connections are internal. An electrical connection is made, it is automatically connected into the flow control and sealed simultaneously.



HYDRAULIC CONTROL module, developed by Kierulff Division of General Precision, Inc. is up to 35% lighter than the original. Module weighs 15 lb., contains all component necessary to pistoning, actuator and provides the module fluid control system.

In action operation, the servo valve directs pressure to one side or the other of the linear hydraulic actuating cylinder, simultaneously venting the opposite side of the cylinder to the tank.

A nitrogen charge initially pressurizes the accumulator. The return pressure is discharged. When the drive motor is energized, the pump forces fluid back into the accumulator. At a later time to raise the pressure of the latter to 3,000 psi. A bypass valve connected across the two sides of the hydraulic actuating cylinder permits automatic isolation of the output control valve when the drive motor is not energized.

The pump motor has an input voltage of 23.5 to 28 v.d.c. and an output current of 12 amps at 28 v. Pump output at rated motor input is 35 gpm. Efficiency is 3,500 psi. mounted.

## USAF Contracts

An Air Force Office of Scientific Research recently awarded \$50,000 and grants with value of more than \$5 million to universities and non-profit and industrial research laboratories.

University of California, Berkeley, Cal.—\$175,000 for research on atmospheric and oceanic pollution.

University of California, Berkeley, Cal.—\$100,000 for research on atmospheric and oceanic pollution.

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Model 80 and Model 65 Beechcraft Queen Air Comparison			
Specifications	Model 65	Model 80	
Gross weight, total	7,700 lb.	7,800 lb.	
Maximum landing weight	7,350 lb.	7,400 lb.	
Empty weight (including unusable fuel)	4,440 lb.	4,400 lb.	
Span	41 ft. 11 1/2 in.	41 ft. 11 1/2 in.	
Length	31 ft. 4 in.	31 ft. 5 in.	
Height to top of fuselage	14 ft. 2 in.	14 ft. 8 in.	
Cabin height	37 in.	37 in.	
Power output (horsepower)	180 hp	180 hp	
Top speed (with optional wing fuel)	230 mph	230 mph	
Price (base aircraft)	\$126,000	\$131,000	
Performance			
Climax speeds (at maximum gross)			
At 10,000 ft. (2,750 gpm)	305 mph	317 mph	
At 15,000 ft. (2,400 gpm)	295 mph	307 mph	
Sea level rate of climb (METO power)	1,500 ft./min.	1,500 ft./min.	
Single engine rate of climb (METO power)	110 ft./min.	271 ft./min.	
Single engine rate of climb (idle power)	240 ft./min.	371 ft./min.	
Climb at maximum gross weight, M80 power			
Sea level, two engines	27,000 ft.	27,000 ft.	
Sea level, single engine	12,000 ft.	12,000 ft.	
Altitude, two engines	25,000 ft.	30,000 ft.	
Altitude, single engine	13,000 ft.	13,000 ft.	
Roll speed, sea level, 7,000 lb. gross weight	36 mph	72 mph	
Roll rate, 30 deg. bank	505 deg./sec.	505 deg./sec.	
Roll maneuverability at altitude			
At 7,000 ft.	36.4 deg.	65.3 deg.	
At 15,000 ft.	36.0 deg.	37.0 deg.	
At 15,000 ft.	36.0 deg.	25.1 deg.	
Cross range at 10,000 ft., average weight, 310 gpm, 40% reserve			
At 7,000 ft.	1,040 mi.	865 mi.	
At 15,000 ft.	1,040 mi.	1,070 mi.	
At 15,000 ft.	1,040 mi.	1,070 mi.	
Tailset distance, 30 deg. flap, maximum gross	1,110 ft.	1,060 ft.	
Ground roll	1,190 ft.	1,450 ft.	
Total over 15 ft. altitude	1,190 ft.	1,450 ft.	
Landing distance, 30 deg. flap, max. landing weight			
Ground roll	1,170 ft.	1,160 ft.	
Total over 30 ft. altitude	1,601 ft.	2,070 ft.	



## When every ounce counts

Mulvey's new Model 405 servomotor weighs only 5 ounces. It is currently specified in many military programs where availability, size, and weight are prime considerations.

The first stage of these miniature valves employs the reliable mechanism of Popper principle used in all Mulvey valves. This allows it to operate and pass on particles as large as 150 microns without malfunctioning.

Reliability: less than 0.5%, backlash 2%, null shift, less than 1%, per 100°F, dry, sealed motor; low 0.5 wattage; flow ranges from 0.1 to 1.25 GPM at 1500 psi drop.

Write for further information.

### Raymond Hickey Division

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### NEW SKYMOND ATCHLEY Jet-Pipe MINIATURE SERVOMOTOR IS DOING A BIG JOB



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**University of Connecticut**, Storrs, Conn. • 41100 for study of differential effects on superconducting film, through.

**University of California, Santa Barbara**, Santa Barbara, Calif. • 41100 for study of superconducting film, through.

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## NEW AEROSPACE PRODUCTS



### Synchro Positioner

Model D-4 angular divider, designed for quality control testing of synchros and resolvers, is used to meet all the Defense Department requirements.

Manufacturers use the instrument can be operated at high speed is, unattended personnel and is adaptable to 20 shaft and bearing configurations from 5 to 37. D-4 has angular accuracy of 15 sec. of arc maximum, 160 deg range, positioning at 1 deg intervals with a detent mechanism and at other angles with a mechanism. The angle device, and has a repeatability of 6 sec. of arc maximum.

Theta Instrument Corp., 520 Victor St., Seattle, Wash., N. J.

### Synchro Test Device

Synchro Test Set Model MST-555A, is designed to measure many synchro characteristics outlined in Department of Defense Specification MIL-S-12705A.

The device has synchronous speed, phase and derating outputs to test electrical zero, electrical zero, load-moment and test rail.

The manufacturer says that regulated operation can test up to 1,000 synchros per month with the test set. The set incorporates electrical zero range of 0.060 deg in 5 deg steps, all range of 0.060 deg in 5 deg steps, self-contained phase sensitive voltmeter and phase reference.

Theta Instrument Corp., 520 Victor St., Seattle, Wash., N. J.



### Fluid Ratio Control

Model 2707 is designed to eliminate fuel-oil ratio ratio shifts in reciprocating engines, regardless of engine speed or drops in fuel pressure. This also can be used to divide one fluid into two equal or unequal quantities. Operation is virtually free of friction due to lack of dynamic seals, the manual feature, and vibration and small errors are minimized by balancing moving elements in a vacuum test.

Provacut, Inc., 11771 River Rd., Santa Fe Springs, Calif.

### Hydraulic Gear Box

Manufacturers use the Model 20427 081-4 gear box offers maximum torque transmission in maximum space to provide torque necessary for driving an aircraft landing gear flap actuator.

Series components include a hydraulic motor rated at 4,000 rpm at 1,940 rpm output shaft speed, a valve with an input flow of 2.71 gpm at 2,600 psi, and gearing which provides the output to output ratio of 6:1 within plus or minus 0.1%. An adjustable reversible stop limits travel to the extent desired.

The gearbox can be supplied with various output shaft configurations, speeds and torques.

Western Electric & Electronics, Divisions of U.S. Industries, Inc., 6712 Hollister Ave., Coletts, Calif.



### Water De-Mineralizer

Plasticized aluminum unit, air-tight and developed by Engine Electric Mfg. Co., Pasadena, N. J., for use in pet hospitals, provides 1,750 lb. per water per hour. Reverse flow and exchange water after water, removing 1.7 lb. of impurities per cubic foot of water.



Check Switch first for your pressure switch requirements.

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## Magneline® ELECTRO-MAGNETIC READOUT INDICATOR

• SILENT  
• RELIABLE  
• EASY TO READ



**SERIES 10300 "PLUG-IN"**  
Machine inserted into front of barrel to make firm connection with shaft block. Twelve characters, 1/4" by 1/4" each. All MAGNELINE characters reversed white on dark black background, do not glow or fade under normal ambient light. Keep in use at 20 feet.



**SERIES 10300 "MINIATURE"**  
Outside dimensions: 1 1/4" high x 2 1/4" wide x 2 1/4" deep. Twelve characters, 1/4" by 1/4" each. All MAGNELINE characters reversed white on dark black background, do not glow or fade under normal ambient light. Keep in use at 20 feet.



**SERIES 10100 "STACKING"**  
1/4" high characters are 1/4" on center, easy to read at 20 feet under normal ambient lighting. Starting from maximum character use in visible panel area, 18 or 22 positions at 6, 25, 25, 25 or 26 volts.

**The MAGNELINE® principle** ensures reliability and long life. A permanent magnet aligns the needle and the specific character line display position. Character is held in position by magnetic field until next pulse.

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## WHO'S WHERE

(Continued from page 25)

### Changes

Walter Dahl, senior technical manager, Peet & Wieting Aircraft Division of United Aircraft Corp., and C. E. Hoffinger, Jr., assistant manager, both offices at the Consultant Advanced Nuclear Engineering Laboratory (CANELL), Middletown, Conn. Also R. Bentler, assistant chief engineer, Cyra Division, General Controls Corp., Davis, Calif. Also S. Thomas Williams, sales manager, General Controls Research Laboratories, Pasadena, Calif.

Dynalco Aircraft Co., Inc., Santa Monica, Calif., has announced the following appointments: Victor S. Corbin, director of performance engineering production, A. J. Quackendorf, director of corporate planning and control.

John J. Murphy, senior Air Force test representative for the Military Electronics Division of Motorola, Inc., with office in Washington, D. C.

A. E. Fivell, director of advance design, Western Division, Northrup Corp., Van Nuys, Calif., and Theodore W. Kaerke, chief of technical staff, propulsion section.

Dr. Frank E. Redlich, chief scientist in the recently established Office of Naval Analysis, a division of the Franklin Institute Laboratories, Philadelphia, Pa.

J. M. Downing, general manager of space engines, Rockwell, a division of North American Aviation Inc., Canoga Park, Calif. Also J. E. Kendall, assistant general manager and chief manager of space engine manufacturing, and S. J. Denosko, chief engineer.

J. E. Thompson, assistant to Mr. Kendall as director of operations, operations—Boe Rockwell and W. B. Free, secretary to Thompson as director of facilities. R. E. Mease, appointed as assistant to Rockwell, also a position responsible for special tool and equipment.

Alexander Salas, director of long range planning, General Precision, Inc., Tarrytown, N. Y.

G. Wesley Marshall, director, engine test planning, Curtiss-Wright Corp.—Wood-Ridge, N. J. Curtis-Wright Centre Division, Caldwell, N. J., has appointed Donald B. Wood to springmounting planning and Jack H. Beale, manufacturing manager.

J. William Culver, manager of plant and program, General Dynamics/Electronics, San Diego, Calif.

John W. Scoville has joined the Engineering Psychology group at Bell Research and Newton, Inc., Cambridge, Mass.

The Chrysler Corp.'s Motorcraft Manufacturing Division, Los Angeles, Calif., has announced the following appointments: Dr. Edward Watts, project engineer, Automotive Fuel & Lubrication, project engineer, Diagnostic Systems, Dr. Bruce Fritsch, senior engineering specialist, Automotive John Watts, project manager for a new experimental control system, being developed, Dr. Paul Schemm, engineering specialist.

Also E. Johnson, management control General Electric Co.'s Air Signal and Control Section, Light Military Electronics Department, Johnson City, N. Y.

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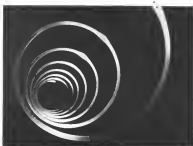
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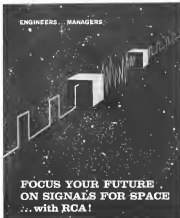
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## PROBLEMATICAL RECREATIONS 116



A drawer contains an odd number of plain brown socks and an even number of plain black socks. What is the least number of brown and black socks such that the probability of choosing two brown socks is  $\frac{1}{5}$  when two socks are chosen at random from the complete collection?

Continued

from our Data Systems Division for unusual cases is digital computer and display systems. We're looking for engineers with new views on the subject. Look up Mr. Harry Lutz if you qualify. Anyone is eligible for a free copy of our third collection of papers from this series, *Practical Nuclear Kinematics*.<sup>3</sup> A card to the same Mr. Lutz will bring the booklet to your door.

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## LETTERS

### Space Oscar

Since medals in the Project Mercury race will descend upon an John Glenn's successful flight, but nowhere have I seen credit to one of the engineers whose product substantially secured this distinction, all of the same. I am speaking of Astron (I am not only not their public address council I am a competitor) who supplied the real hand-held covers and the film which which Glenn successfully shot so many photographs. For a commercial view of space travel, as evidenced by a Mid Spec, to feature in America is a credit to the designers and manufacturers.

Alan Cassano, President  
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North Hollywood, Calif

### A Patent Case

The issue of ownership of patents on inventions developed abroad to work on government facilities has created considerable alarm and confusion throughout the country—both in political and industrial circles as well as among balanced personnel.

There appears to be two highly vocal and apparently opposed viewpoints on the matter. The first is that the government is to place substantial funds in pay for scientific research and development facilities to more political and government people's interest in full ownership of patent rights by the government so interference with the private program has been limited. On the other hand, many countries have not only strongly emphasized the fact that man power, facilities, planning and direction is provided by the contractor in addition to a proportion of the funds and, therefore, the government does not logically deserve complete ownership of the patent rights, and that some sharing between the government and the contractor would facilitate the more complete. In Department of Defense, this doctrine is prominently displayed by extending rights to the contractor for full utilization of the patent while retaining the patent itself in the hands of the contractor.

The matter is possible for the contractor to develop and profit from any commercial product which the patent may provide while at the same time providing the government use.

It appears to me that the two viewpoints do have merit. It is true that the full profit from patent rights should go to those who provide the money and to pay for the development of an invention that is a viable device.

In all the extensive debate which is going on, the contribution of the individuals who develop the ideas which the invention has been developed is ignored. Only commercial issues in mind, I maintain that no item that has ever been produced solely by the spending of money. I am also convinced that no invention has ever been produced solely by management means, extensive facilities or organization alone. Although these ingredients are desirable, and possible

*Astron Work welcomes the comment of its readers on the issues raised by the magazine's editorial columns. Address letters to the Editor, Astron Work, 1380 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but letters of writers will be withheld on request.*

in modern times essential by themselves for a completely capable of producing new ideas, by the direction of individual thinking in talented individuals can a new idea arise. In addition to funds and organization, another ingredient is necessary to produce useful new ideas resulting in patents—the third ingredient being the intelligence, initiative, ability, ideas, hard work, or sometimes pure genius combinations, of an individual.

In my opinion the contribution to the industrial scientist or engineer is rewarded by providing a clear-cut profit resulting from his invention. I doubt very much however, that the sharing of profits is in proportion to the contribution—both in political and industrial circles—rights in space include the Navy Space Test Satellite System as a part of Space Truck, and the Navy's original sole use of the spacecraft space station, via, the Titan navigational vehicle.

Statements such as the aforementioned, although not convincing as an argument and only descending to the general public, but also descending to those who are in control of satellite defense and testing as in the commercial.

A more recent statement of fact concerning the United States Naval Space Surveillance System, is reported in the NORAD Space Detection and Tracking System, as quoted from the speech of the Secretary of Defense, Robert S. McNamara, before the House Committee on Armed Services.

"Clearly related to the problem of defense against ICBM attack is the potential problem of defense against satellite attack. The first task in the defense track against satellites is to detect them. This we are doing through the NORAD Space Detection and Tracking System (SPADASTR).

"This system consists of two major components both under the control of NORAD: The Navy's Space Surveillance System (SPASUR) operates a series of detection facilities across the southern United States and a computer and command center located at Phillips, Va. The second component of SPADASTR is the Pacific Space Truck System. It is a series of orbiters located on the North American coastline."

While these statements of government patent law are all presented against patent holders, all presented against patent holders.

• Ownership of the patent by the contractor, provided the company had a patent policy adequately compensating the contractor.

• Reversion of rights to the government when the government helped finance the development as part of a contract.

• Exclusive commercial rights to the contractor if he has made proper provision to share some profits arising from such commercial rights with the contractor.

John M. Patterson  
President  
Astron Enterprises, Inc.  
Glenview, Md

### Navy Surveillance

Under the "State Attorney" paragraph of the "Navy Space to Soviet Undersea Challenge" article in the May, 11 issue of Astron Work and Space Technology (1967), has announced that the Navy position in space includes the Navy Space Test Satellite System as a part of Space Truck, and the Navy's original sole use of the spacecraft space station, via, the Titan navigational vehicle.

Statements such as the aforementioned, although not convincing as an argument and only descending to the general public, but also descending to those who are in control of satellite defense and testing as in the commercial.

A more recent statement of fact concerning the United States Naval Space Surveillance System, is reported in the NORAD Space Detection and Tracking System, as quoted from the speech of the Secretary of Defense, Robert S. McNamara, before the House Committee on Armed Services.

"Clearly related to the problem of defense against ICBM attack is the potential problem of defense against satellite attack. The first task in the defense track against satellites is to detect them. This we are doing through the NORAD Space Detection and Tracking System (SPADASTR).

"This system consists of two major components both under the control of NORAD: The Navy's Space Surveillance System (SPASUR) operates a series of detection facilities across the southern United States and a computer and command center located at Phillips, Va. The second component of SPADASTR is the Pacific Space Truck System. It is a series of orbiters located on the North American coastline."

Although a statement about the Titan is not mentioned regarding the Navy's only operational space station, no doubt refers to the Navy's only satellite launching project; the contractor is misleading. It is the U. S. Naval Space Surveillance System that is really referred to as the Navy's first operational space station.

D. G. Wren  
1010 N. 10th St.  
Concord, Calif.  
Commanding Officer  
U. S. Naval Space Surveillance System  
Del Mar, Va

## Information About Hose Made of Teflon From The People Who Invented It

No. 1 in a series

### SIGNIFICANCE OF COLOR

Resistoflex originated and in 1953 introduced hose assemblies made of Teflon<sup>®</sup> via gas turbine applications. Since then millions of assemblies have gone into service in all areas of the aero-space industry, and an outstanding record for performance and reliability has been compiled.

You have undoubtedly observed hose tubing made of Teflon in many colors, with black being predominant. Black is the color of the hose developed and manufactured to this day by Resistoflex. In fact, Resistoflex and its licensees, here and abroad, manufacture black hose ONLY.

The black color is a result of a carbon black component being added to the Teflon extrusion compound by a process covered by Resistoflex Patent No. 2,752,637. The purpose of the carbon black is to act as a moderator for the large liquid extrusion-lubricant fraction of the Teflon resin mix. Its excellent absorption characteristics and fine particle size provide millions of macroscopic lubricant reservoirs uniformly dispersed throughout the mix. Despite the

most exacting controls, Teflon resin displays a wide range of lubricant retention capability. Hence, the carbon black particles, in their function as a moderating agent, serve as suppliers of additional lubricant or reservoirs of excess lubricant during the passage of the resin mix through the vital constricting throat of the tubing extrusion die. For this reason black tubing has consistently shown uniformity of structure.

Some have assumed carbon black was merely a color coding for identification. Some have even thought coloring was to hide defects. Some extruders used, because of their poor dispersal characteristics, have resulted in serious agglomeration problems and unreliable structures. Unchecked hose, while not aggravated by the improper use of pigment, continues to be plagued by structural defects resulting from the variation in resin lubricant absorption capability.

Therefore, Resistoflex will continue to manufacture black hose by the same methods that have been as well proven in field service.

Resistoflex extrudes its hose and tubing in Teflon under the name Resistoflex.

**RESISTOFLEX**  
**RELIABILITY**

ANAHEIM • ROSELAND • DALLAS

SALES OFFICES: Atlanta • Chicago • Cleveland • Denver • Detroit • Houston • Los Angeles • Miami • New York • Philadelphia • San Diego • San Francisco • Seattle • St. Louis • Washington

# "hot" fastening problems with temperature Elastic Stop® nuts

ESNA, pioneer producer of self-locking nuts to military specifications, has solved hundreds of specialized problems related to the destructive effects of extreme heat (or cold!) on bolted connections.

All of the parts shown here—as well as most of the high-temperature designs now accepted as standard for assembling gas turbine engines—originated and were first tested in ESNA's labs.

HEAT COLORS AND APPROXIMATE MAXIMUM  
WORKING TEMPERATURES OF VARIOUS METALS

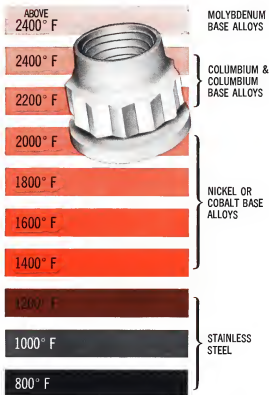
## Is your work in these areas?

Recent ESNA engineering developments include:

1. A lightweight nut to carry small tensile loads for at least 30 minutes at 2000°F while retaining locking torque, and to be removable from the bolt after exposure.
2. A nut for use in a radioactive environment, at temperatures to 1200°F, which can be assembled/disassembled by a limited-strength robot hand.
3. A nut for space vehicles which can endure short periods at up to 2700°F while maintaining locking torque resistant to high vibrational loads when returned to lower temperatures.

## Come to ESNA for solutions— ready-made or custom-tailored

ESNA may be able to suggest a standard production item to solve your high temperature application problem. If no ready-made answer exists, ESNA has the capability—and the interest—to work with you in the creation of a special solution. Call Murdock 6-6000, Ext. 201, for engineering assistance. For information about standard high temperature Elastic Stop nuts, write Dept. S74-425.



## Some practical ESNA solutions



LH3858

Reduced hex, lightweight nuts to develop full tensile strength of bolts of 140 KSI at temperatures —300°F to 900°F. A286 stainless steel, silver plated. Sizes 2—56 through 3/8"–24.



LH3610

Special close-clearance nuts to develop tensile strength of 160 KSI at temperatures to 900°F when used on bolts of same material. AMS-6304 chrome moly vanadium steel, silver plated. Sizes 10—32 through 3/8"–24.



LH4167

High performance nuts to develop full strength (160 KSI) of bolts of same material at temperatures —300°F to 1400°F. Used for reduced times and loads up to 1800°F. Rene 41, silver plated. Sizes 10—32 through 3/8"–24.



ZL4361

Shank type nut for turbine flange sections. Develops full tensile strength of Waspalloy bolts up to 1400°F. Waspalloy PWA686, silver plated. 1/4-28 size, two shank lengths.



RG38-2644

Radial gang nut strip for flange assemblies, to develop full strength of bolts of 347FM or 303 stainless steel at 1200°F. Nut—AISI 347-FM, silver plated, size 5/16"–24. Channel—AISI 321 passivated.



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